Contract No.: EP-W-09-002
WA #: 022-TATA-028E

Region 2 RAC2
Remedial Action Contract

2012 Annual Groundwater Data Evaluation Report

Zschiegner Refining Company Site

Technical Assistance Activities

Hopewell Township, New Jersey

March 7, 2013

CDM Smith

CDM Smith

14 Wall Street, Suite 1702
New York, New York 10005
tel: +1 212 785-9123
fax: +1 212 227-1692
cdmsmith.com

March 7, 2013

Ms. Stephanie Vaughn
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 19th Floor
New York, NY 10007

PROJECT: Region 2, RAC2 Contract No.: EP-W-09-002
Work Assignment No.: 022-TATA-028E

DOCUMENT NO.: 3320-022-01783

SUBJECT: 2012 Annual Groundwater Data Evaluation Report
Zschiegner Refining Company Site
Technical Assistance Activities
Howell Township, New Jersey

Dear Ms. Vaughn:

CDM Federal Programs Corporation (CDM Smith) is pleased to submit this Groundwater Data Evaluation Report for the Technical Assistance Activities for the Zschiegner Refining Company Site in Howell Township, New Jersey.

If you have any comments concerning this submittal, please contact me at (732) 590-4663.

Very truly yours,

CDM FEDERAL PROGRAMS CORPORATION

Paul Hagerman, P.E
Site Manager

PSO:

Attachment
cc:
A. States, EPA Region 2(Letter only)
D. Butler, EPA Region 2(Letter only)
B. MacDonald, CDM Smith (Letter only)
RAC2 Document Control

Table of Contents

List of Figures

List of Tables

Appendices

Section 1
Introduction

Under the Region 2, RAC2 Contract No.: EP-W-09-002 Work Assignment No.: 022-TATA-028E, CDM Federal Programs Corporation (CDM Smith) has been tasked to perform Technical Assistance Activities at the Zschiegner Refining Company (ZRC) Site (Site) located in Howell Township, Monmouth County, New Jersey. The service is performed in order to satisfy the remedy set forth in the Record of Decision (ROD) issued by the United States Environmental Protection Agency (EPA) for the Site.

CDM Smith performed post-construction groundwater and wetland restoration monitoring at the Site as defined in the ROD (EPA 2004), the Final Groundwater Monitoring Plan (CDM Smith 2008a), and the Final Wetland Monitoring Plan, (CDM Smith 2008b). Based on EPA's approval, CDM Smith collected four rounds of groundwater samples from 16 monitoring wells in 2012.

This report is the third and final annual report of a 3-year, long-term groundwater monitoring program. It summarizes the field activities and results of the Rounds 9 through 12 (2012) groundwater sampling events, assesses the effectiveness of the soil remedy in mitigating elevated contaminant levels in groundwater, and provides recommendations for further actions. This report is organized into five sections:

- Section 1 – Introduction
- Section 2 – Field Activities
- Section 3 – Field Activity Results
- Section 4 – Recommendations
- Section 5 – References

1.1 Site Description and History

The ZRC Site is a 6.1-acre former metals refining facility located in a rural residential area of Howell Township, Monmouth County, New Jersey (Figure 1-1). Haystack Brook and its associated wetlands run north-south on the eastern portion of the property and a small pond is situated on an adjacent property immediately southeast of the Site. Maxim-Southard Road and the Candlewood residential development are located west of the property. A single-story building was located on the Site about 140 feet east of Maxim-Southard Road, but was later demolished. Two homes border the Site; the closest house is within 150 feet of the former onsite building. A public drinking water well serving approximately 48,000 people is located 6.5 miles from the Site; private wells serve the site's three closest neighbors.

ZRC operated from 1964 to 1992 as a precious metals recovery facility. Operations included the chemical stripping of precious metals from watch bands, photographic film, and electrical components. At some point, the owner began the illegal manufacturing of methamphetamine. The

facility was raided in October 1992 by the U.S. Drug Enforcement Agency (DEA). At the time of the raid, approximately 3,000 different chemicals including peroxides, cyanides, caustics, and acids were found improperly stored at the facility.

From November 1992 through November 1995, a removal action and sampling were conducted by EPA. The sampling effort revealed the presence of inorganic contaminants in the onsite soil and downstream surface water and sediment. A Hazard Ranking System (HRS) report was prepared for the Site in December 1997, and the Site was placed on the National Priorities List (NPL) in March 1998.

From September 1998 through June 2004, a remedial investigation/feasibility study (RI/FS) was completed for the ZRC Site to determine the nature and extent of contamination and to develop remedial action objectives and remedial alternatives. Samples were collected from surface soil, subsurface soil, wetland sediment, groundwater, wetland seeps, surface water and sediment from Haystack Brook and the pond, and building materials. In general, samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals.

In September 2004, the EPA issued a ROD (EPA 2004), which called for the remediation of soil, sediment and groundwater at the Site. The remedial design was finalized in January 2007 and the onsite building was demolished and disposed off site in February 2007. Field work for the remedial action was initiated in June 2007 and completed in October 2008. A total of 10,425 cubic yards (yd^3) of contaminated upland soil and 15,351 yd^3 of contaminated wetland soil were excavated and disposed off-site during the remedial action. Groundwater and wetland restoration monitoring are ongoing.

1.2 Site Geology and Hydrogeology

The following stratigraphy was encountered in lithologic samples collected during the geological and hydrogeological investigation as part of the RI (CDM Smith 2004) for the Site.

- Topsoil
- Silty Fine Sand and Gravel
- Silt-Clay
- Sand
- Silt-Clay

Topsoil - Topsoil is approximately six inches thick, composed of decaying organic matter and greyish-brown sand.

Silty Fine Sand and Gravel - Underlying the topsoil unit is a silty sand and gravel deposit. Slight variations in lithology were observed, but the deposit generally is fine sand with some silt, and trace to some fine to medium gravel and some amounts of silt. The typical thickness reported for the unit varies between 13 and 29 feet. The thickness is controlled chiefly by topography; it is thinner in the low-lying areas where it has been eroded and thicker in areas of higher elevation.

Silt-Clay - The silt-clay unit consists of a silt-dominated lithostratigraphic unit that can be mapped across the area. The unit generally is a poorly sorted succession of silt and clay with minor proportions of very fine sand. Locally, the unit includes thin fine to coarse-grained sand layers. The silt-clay unit does not appear to fluctuate greatly in thickness across the Site, from a minimum of 29 feet to a maximum of 37 feet thick; on average, the unit is 30 feet thick. This silt-clay confining layer separates a shallow groundwater aquifer from a deeper one.

Sand - Immediately underlying the silt-clay unit is an approximately 10 foot-thick unit of dark grey, fine to coarse-grained quartz sand, commonly with trace amounts of fine gravel, silt or clay, and occasionally is interbedded with thin beds (less than six inches thick) of fine silty sand. The unit fines downwards into interbedded silty sands and silts in all deep monitoring well borings installed during the RI.

Silt-Clay - From 0.5 to 1 foot of silt-clay was encountered at the bottom of each deep monitoring well boring. The appearance was similar to the silt-clay unit above. Details regarding this unit's thickness and continuity are not known.

The water table is a subdued expression of the site's topography, with the highest elevations on either side of the wetland area and lowest elevations along Haystack Brook and beneath the wetland. Shallow groundwater flow direction is southeast from the ZRC property towards the wetland and Haystack Brook. Water level elevation data indicate the water table is approximately nine feet below ground surface (bgs) in areas immediately upgradient of the ZRC Site, approximately four feet bgs at the former location of the facility building, and at or just below ground surface within the wetland area. These data indicate groundwater in the shallow aquifer unit flows beneath the ZRC facility and discharges directly into the surface waters of the wetland and Haystack Brook.

The deep aquifer potentiometric surface is less affected by surface topography. The potentiometric surface is flatter and its gradient is smoother than the water table. The potentiometric surface gradient is towards the east-southeast, suggesting the flow direction in the deep aquifer is towards the east-southeast, from the ZRC property towards the wetland and Haystack Brook. Water level elevation data indicate the potentiometric surface is approximately 10 feet bgs in areas immediately upgradient of the ZRC Site, approximately three feet bgs at the former location of the facility building, and at or above ground surface within the wetland area.

1.3 Extent of Groundwater Contamination Found in Remedial Investigation

During the RI, the nature and extent of groundwater contamination at the ZRC Site was substantially defined. Groundwater samples indicated that shallow groundwater at the Site was contaminated with metals. The shallow groundwater contamination was limited to the area between the former location of the facility building and Haystack Brook and was characterized by chromium and nickel levels that exceed National Primary Drinking Water Standards and New Jersey Groundwater Quality Standards.

Analytical results indicated that deep groundwater was not impacted (EPA 2004). In addition, hydrogeologic conditions make contamination of the deep aquifer unlikely due to the dense silt-clay confining layer. Downgradient residential wells were not sampled during the RI.

Aluminum and iron were detected at concentrations that exceed New Jersey secondary maximum contaminant levels (SMCL) in numerous groundwater samples collected from monitoring wells and residential wells. Elevated concentrations of both metals are indicative of the Pine Barrens soil and groundwater. Elevated concentrations of both aluminum and iron were also detected in upgradient monitoring wells and residential wells; therefore, the elevated concentrations do not appear to be related to the ZRC Site.

During the RI/FS, the inorganic analytes chromium, copper, and nickel were selected as indicator contaminants to represent contamination at the ZRC Site. These indicator contaminants were determined by: (1) frequency of exceedance of screening criteria; (2) magnitude of exceedance of screening criteria; (3) overall spatial distribution; and (4) historical use onsite.

1.4 Record of Decision

In September 2004, the EPA issued a ROD (EPA 2004), which called for the remediation of soil, sediment and groundwater at the Site. The EPA determined that a combination of remedial alternatives were the appropriate remedy because it best satisfied the requirements of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the nine evaluation criteria for remedial alternatives in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The major components of the selected remedy included:

- Excavation of an estimated 1,750 yd^3 of contaminated surface soil and 1,240 yd^3 of subsurface soil, sampling to verify the Site cleanup criteria were met, backfill with clean fill, and restoration
- Excavation of an estimated 4,500 yd^3 of contaminated sediment from the wetland and a small portion of Haystack Brook adjacent to the Site, backfill, and restoration with monitoring
- Transportation of contaminated soil and sediment off-site for disposal
- Demolition, without replacement, of the on-site building to allow for the excavation of the contaminated soil beneath it
- Monitoring of contaminated groundwater for a period of 3 years after removal of the contaminated subsurface soil to determine if contaminant levels are being sufficiently reduced by the source removal

1.5 Remedial Action Requirements

In accordance with the ROD, CDM Smith performed quarterly groundwater monitoring for a period of 3 years (2010 to 2012). Based on the results of the groundwater monitoring program, EPA may elect to discontinue the monitoring program, extend the monitoring program, or enact the active remedy described in Alternative GW3 of the Final Groundwater Monitoring Plan. Alternative GW3 includes a permeable reactive barrier, institutional controls, and long-term monitoring. As part of this

alternative, a permeable reactive barrier would be installed downgradient from the plume area. The permeable barrier would employ a reactive medium to immobilize or chemically modify contaminants to a less harmful form. Section 4 provides recommendations for future activities based on evaluation of the data collected during the monitoring program.

The data in this report is being compared to the remedial goals set forth in Table 11 of Appendix II in the ROD in order to verify the effectiveness of the remedy

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Section 2
Field Activities

The objectives of the 2012 quarterly groundwater sampling events are to provide groundwater monitoring results and synoptic water levels from 16 monitoring wells. The field activities are described below.

2.1 Synoptic Water Level Measurements

Synoptic water level measurements were collected to determine groundwater flow direction. During each quarterly monitoring event, one round of synoptic water level measurements was collected from 16 monitoring wells. Water level meters were used to measure the water level and the total depth of each well from a surveyed reference point marked on the top of the inner casing of each well. Table 2-1 summarizes water level measurements collected during each round. Monitoring well locations are depicted on Figure 2-1.

2.2 Groundwater Sampling

EPA Region 2 low-flow groundwater sampling procedures were followed during the March 19, 2012 through December 27, 2012 quarterly groundwater sampling. The depth to bottom of the 12 shallow monitoring wells range from 7.82 to 17 feet bgs and the depths of the four deep monitoring wells range from 55.5 to 70.76 feet bgs.

Appendix B, Table 1 summarizes the samples collected and analyses performed. During Rounds 9, 10, and 12, groundwater samples for Target Analyte List (TAL) metals were analyzed through the EPA Division of Environmental Science and Assessment (DESA) laboratory located in Edison, New Jersey. During Round 11, groundwater samples for TAL metals were analyzed through EPA's Contract Laboratory Program (CLP) laboratory. Samples for dissolved organic carbon (DOC), total dissolved solids (TDS), total organic carbon (TOC), and total suspended solids (TSS) were sent to the DESA laboratory during Rounds 9 through 12. Hardness was calculated during all four rounds.

One field duplicate was collected per day in each round. MW-11S was selected as the duplicate sample location since this area has had consistent high levels of contamination.

Investigation derived waste (IDW) was collected and stored in ten 55-gallon drums. Seacoast Environmental, CDM Smith's IDW disposal subcontractor removed five non-hazardous water drums and one personal protective equipment (PPE) drum from the site on July 24, 2012, and three non-hazardous water drums and one PPE drum on February 12, 2013. All drums were transported to Environmental Recovery Corporation in Lancaster, Pennsylvania.

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Section 3
Field Activity Results

This section provides the results of quarterly groundwater samples and synoptic water levels collected from the 16 wells in 2012.

3.1 Potentiometric Surfaces

The RI found that the potentiometric surface gradient is towards the east-southeast, suggesting the flow direction in the deep aquifer is towards the east-southeast, from the ZRC property towards the wetland and Haystack Brook. Water level elevation data indicated the potentiometric surface was approximately 12 feet bgs in areas immediately upgradient of the ZRC Site, approximately three feet bgs at the former facility building location, and at or above ground surface within the wetland area. Data indicates that the vertical flow gradient between the two aquifers is slightly downward in the area upgradient of the ZRC Site but is upward from the location of the former building southeastwards to the wetland, at least as far as MW-1D.

Potentiometric surface contours were developed for the shallow aquifer based on synoptic water levels collected during Rounds 9 through 12. These water table contours are provided in Figures 3-1 through 3-4. The water table contour maps indicate that groundwater flow direction in the shallow zone is generally unchanged from the groundwater flow direction identified during the RI. Water levels were similar in Rounds 9 through 11, and highest in Round 12 due to excessive rain during the event. Water table contours were not created for the deep zone due to minimal contamination.

3.2 Groundwater Sampling Results

To evaluate the effectiveness of the remedial action, groundwater samples were analyzed for TAL metals, DOC, TOC, TDS and TSS because of the heavy metal presence in the floodplain and wetland area adjacent to the ZRC Site before the remedial action.

Analytical results for groundwater samples were compared to the New Jersey Class IIA Groundwater Quality Standards (NJ GWQS), as amended on July 22, 2010, and the remedial goals established in the ROD. New Jersey drinking water standards were also considered, however, the NJ GWQS are in all cases as stringent as or more stringent than the New Jersey drinking water standards. Table 3-1 summarizes the analytical results for groundwater samples collected in Rounds 9 through 12.

In addition to the laboratory analytical results, field water quality parameters including pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, conductivity, and temperature were recorded during the sampling activities. Final groundwater quality readings are provided in Table 3-2.

Monitoring well sampling field data sheets are presented in Appendix A.

3.3 Contaminant Distribution

The network of groundwater monitoring wells is spread across the Site in areas upgradient, in an unimpacted area, within the remediated area, and downgradient of the remediated area both west and east of Haystack Brook (Figure 2-1). The contaminant distribution across these areas is discussed separately for the shallow and deep aquifers. The contaminants of concern (COCs) are chromium and nickel. As set forth in the ROD, the remediation goal for both COCs is 100 micrograms per liter (µg/L). Figure 3-5 provides analytical results of COCs for monitoring wells sampled in 2012.

3.3.1 Shallow Aquifer

In Rounds 9 through 12, COC exceedances of remediation goals were observed in well MW-03RS and MW-11S. No exceedances of remediation goals were recorded at former contaminated well MW-04RS. Figure 3-6 provides concentration trends for chromium and nickel at these locations from December 2009 through December 2012. Results of the Rounds 9 through 12 monitoring for wells in the shallow aquifer are summarized below:

- In well MW-03RS (Figure 3-6a), located in the remediated area downgradient of the former facility, chromium concentrations ranged from 170 µg/L to 390 µg/L. The most recent detection of 170 µg/L is the lowest concentration of the 12 round sampling period. Nickel concentrations ranged from 500 µg/L to 1190 µg/L. Nickel concentrations decreased every round in 2012, but remained above the remediation goal.
- In well MW-04RS (Figure 3-6b), located in the remediated area downgradient of the former facility, concentrations remained below the remediation goals during Rounds 9 through 12.
- In well MW-11S (Figure 3-6c), located in the pre-remedial “hotspot” downgradient of the former facility, chromium concentrations ranged from 115 µg/L to 150 µg/L, and nickel concentrations ranged from 220 µg/L to 380 µg/L, which remain above remediation goals.

3.3.2 Deep Aquifer

The deep aquifer contains little contamination. There were no exceedances of COC remediation goals in the four deep aquifer monitoring wells sampled during Rounds 9 through 12.

3.3.3 Cross Sections

Two cross sections (A-A' and B-B’) extending downgradient from the remediated area were prepared for each round of sampling data. The locations of these cross sections are shown in Figure 3-7. Cross sections A-A' and B-B' corresponding to each sampling event are provided in Figures 3-8 through 3-15. Concentrations of chromium and nickel overall have decreased since June 2011, but still exceed the remediation goal of 100 µg/L in two wells: MW-11S (cross section A-A’) and MW-03RS (cross section B-B').

3.3.4 Trend Analysis for Rounds 1 through 12

To assess temporal trends in the COC concentrations over the 3-year monitoring period groundwater data for chromium and nickel were graphed for selected wells. Chromium and nickel monitoring data for three wells, MW-03RS, MW-04RS, and MW-11S, were plotted vs. time. The data plots are shown in

Figure 3-6. Summaries of the concentration trends observed in each of the three selected wells are provided below:

- MW-03RS – The nickel concentration was at its lowest level of 326 µg/L in Round 1 and rose to its highest level of 1,700 µg/L in Round 6. The nickel concentration has decreased in all subsequent rounds, decreasing to 500 µg/L in Round 12. The chromium concentration has decreased from over 1,040J µg/L in Round 1 to its current level of 170 µg/L, approaching the ROD criterion of 100 µg/L.
- MW-11S – The nickel concentration rose from approximately 499J µg/L in Round 1 to 1,600 µg/L in Round 4. The nickel concentration decreased to a new low level of 220 µg/L in Round 12. The chromium concentration was below the ROD criterion in the first 7 rounds of sampling, but has increased to slightly above the ROD criterion in Rounds 8 through 12, with the current concentration at 140 µg/L.
- MW-04RS – The nickel concentration was at its highest level in Round 1 (367J µg/L). The nickel concentration decreased to a non-detect level during Round 2 and increased to 220 µg/L during Round 3. Nickel concentrations have been below the ROD criterion of 100 µg/L since Round 8. The chromium concentration marginally exceeded the ROD criterion in Rounds 1, 3, and 4, but has been below the ROD criterion since Round 5.

3.4 Quality Assurance and Quality Control

The groundwater samples for Rounds 9 through 12 were analyzed and the data were validated and qualified according to EPA Region 2 laboratory Standard Operating Procedures (SOPs). The results for metals and wet chemistry parameters are considered accurate and defensible as reported.

Quality assurance and quality control (QA/QC) measures were taken in the field in accordance with the EPA approved Quality Assurance Project Plan (QAPP) (CDM Smith 2010). The QA/QC samples collected during each round included one field duplicate and matrix spike duplicate per event and one field blank per day. A data usability report for each sampling event is provided in Appendix B. QA/QC sample information is summarized on Table 1 of each data usability report. Key information in the data usability report is summarized in this section.

3.4.1 Blank Contamination

Blank contaminants are listed and evaluated in the data usability worksheets in Appendix B. The concentrations of contaminants detected in the laboratory blanks associated with these sampling events were evaluated. No action was required for arsenic, calcium, copper, iron, manganese, nickel, vanadium and zinc although detected in at least one field blank below the contract required quantitation limits (CRQLs). Aluminum, chromium, manganese, and zinc were detected above their CRQLs in the field blanks; no sample results qualifications were required. Detailed data usability reports are included in Appendix B.

3.4.2 Field Duplicate Sample Comparison

The relative percent differences (RPDs) or absolute differences for the four pairs of field duplicate samples were calculated to determine the precision of laboratory results. The duplicate criteria were met for all contaminants of concern, demonstrating overall good precision in the data.

3.4.3 Data Completeness

Completeness for sample collection is defined as the percentage of samples listed in the QAPP that actually were collected during the field program. It is also defined as the percentage of measurements whose results are judged to be valid.

Groundwater and QC sample collection met the QAPP completeness goal of 90 percent for Rounds 9 through 12. Two metal results, approximately 0.13 percent of all metal results, were rejected due to the field blank result. Overall a completeness of 99.87 percent was achieved for these sampling events.

3.4.4 Field Measurements

Using the EPA Region II low flow sampling method, groundwater parameters of pH, conductivity, turbidity, DO, ORP, and temperature were measured. No problems occurred during collection of these parameters.

Section 4
Recommendations

Concentrations of COCs at the Site have reduced and are trending lower, but still remain above the ROD criteria at MW-03RS and MW-11S. CDM Smith recommends continuation of the post-construction groundwater monitoring program to determine if COC concentrations in these wells drop below remediation goals specified in the ROD.

Since several of the wells have had minimal or no detections during the 2009 to 2012 monitoring period, sampling of a more limited number of wells will provide sufficient data to continue evaluation of the effectiveness of the soil remedy at addressing groundwater contamination. It is recommended that monitoring continue at the following wells: MW-03RS and MW-11S, formerly contaminated well MW-04RS, background wells MW-07D and MW-07S, deep aquifer well MW-03RD, and downgradient wells MW-09S and MW-10S. Figure 4-1 provides the locations of the wells proposed for continued sampling.

To provide data to assess the impact of changes in groundwater flow or water levels on COC concentrations in groundwater, collection of synoptic water levels at all sixteen wells is recommended.

CDM Smith recommends the following activities in 2013 and 2014:

- Semi-annual groundwater sampling of eight monitoring wells (MW-03RD, MW-03RS, MW-04RS, MW-07D, MW-07S, MW-09S, MW-10S, MW-11S)
- Semi-annual synoptic water levels during the groundwater sampling events of sixteen monitoring wells (MW-01S, MW-01D, MW-02RS, MW-03RD, MW-03RS, MW-04RS, MW-05D, MW-05S, MW-06RS, MW-07D, MW-07S, MW-08S, MW-09S, MW-10S, MW-11S, MW-12S)
- Four data evaluation reports presenting results of years 4 and 5 of the post-construction groundwater monitoring program

During 2013, contaminant trends will be evaluated to determine whether it is feasible to reduce the sampling frequency to an annual basis.

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Section 5
References

CDM Federal Programs Corporation (CDM Smith). 2004. Final Remedial Investigation Report, Zschiegner Refining Company Superfund Site, Remedial Investigation/Feasibility Study (RI/FS), Howell, New Jersey. July 1.

_____. 2010. Final Quality Assurance Project Plan, Zschiegner Refining Company Superfund Site, Howell, New Jersey. August 6.

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_____. 2008b. Final Wetland Monitoring Plan, Zschiegner Refining Company Superfund Site, Howell, New Jersey. November 10.

United States Environmental Protection Agency (EPA). 2004. Final Record of Decision (ROD), Zschiegner Refining Company Superfund Site, Howell, New Jersey, September 2004

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Figures

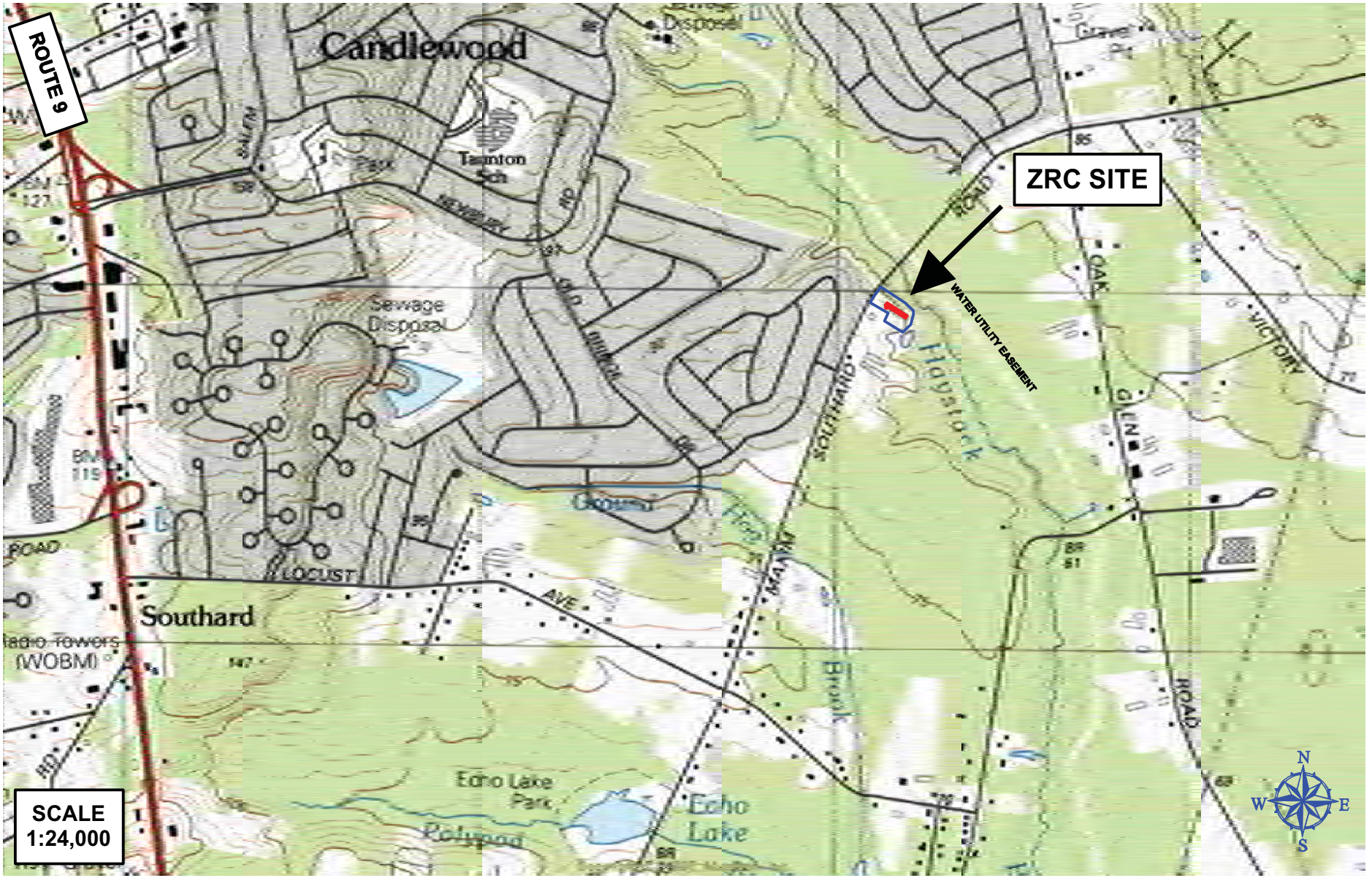

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Figure 1-1
Site Location Map
Zschiegner Refining Co. Site
Howell, New Jersey

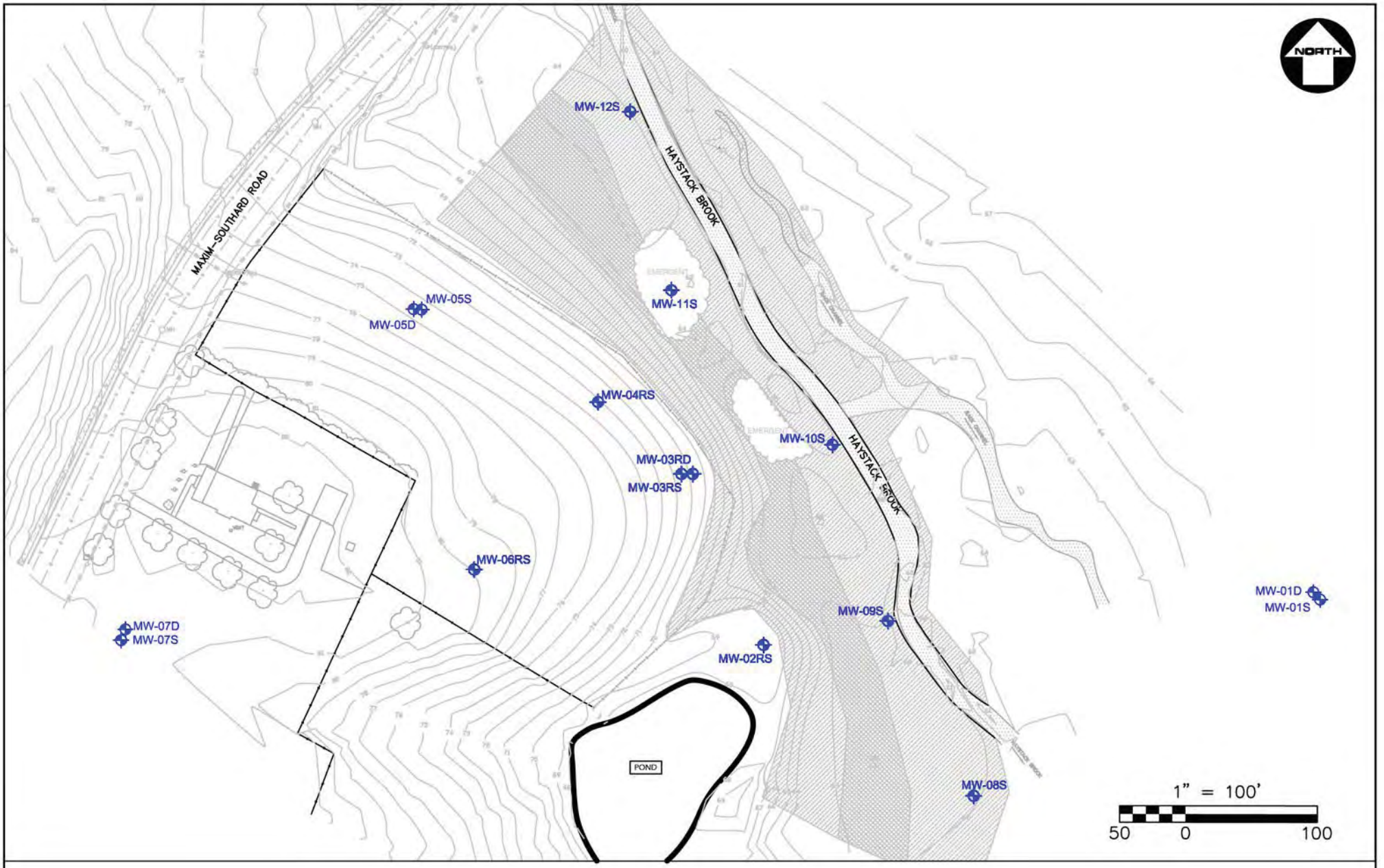

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Figure 2-1
Monitoring Well Locations
Zschiegner Refining Company Site
Howell, New Jersey

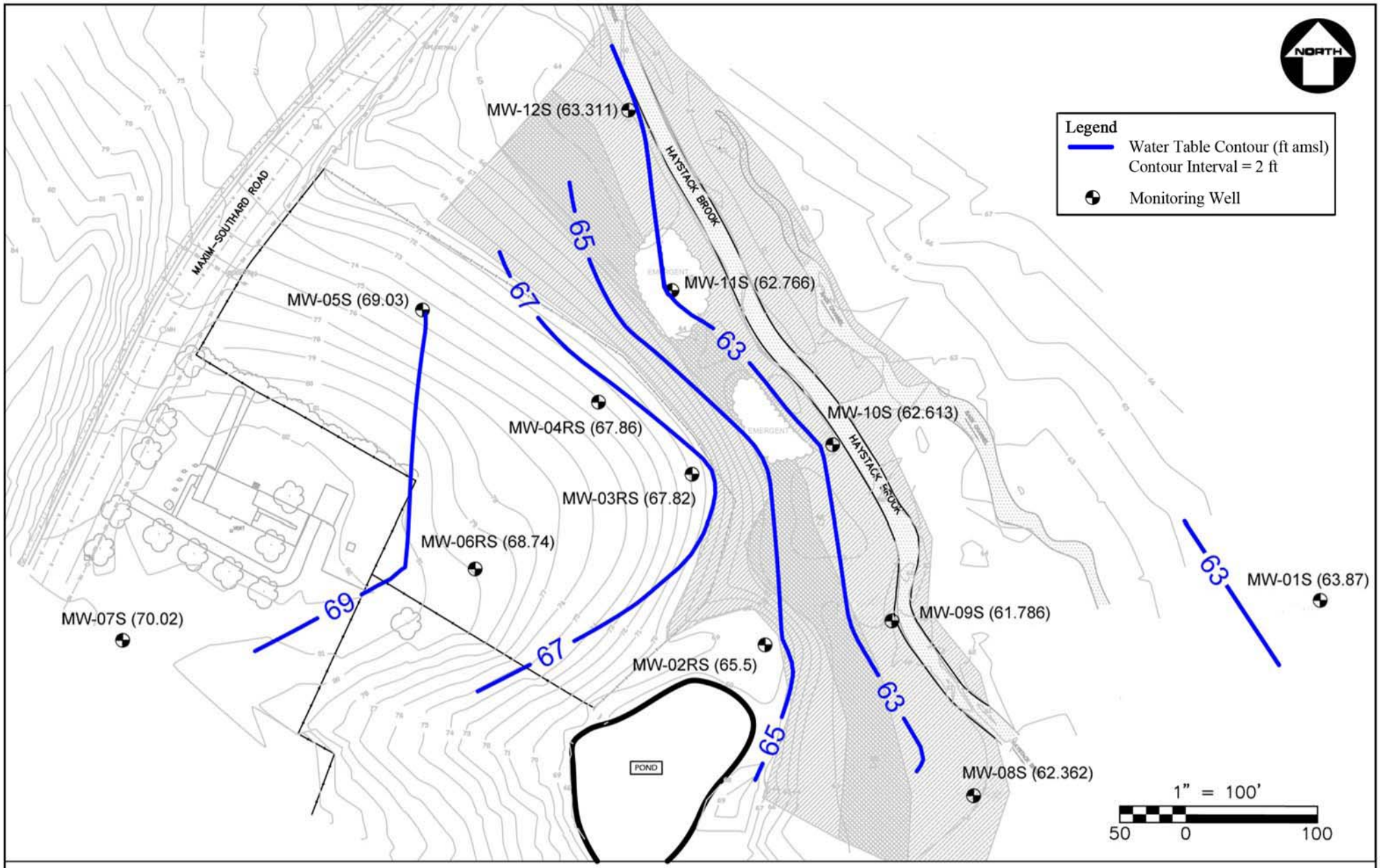


Figure 3-1
Water Table Contour Map
March 19, 2012
Zschiegner Refining Company Site
Howell, New Jersey

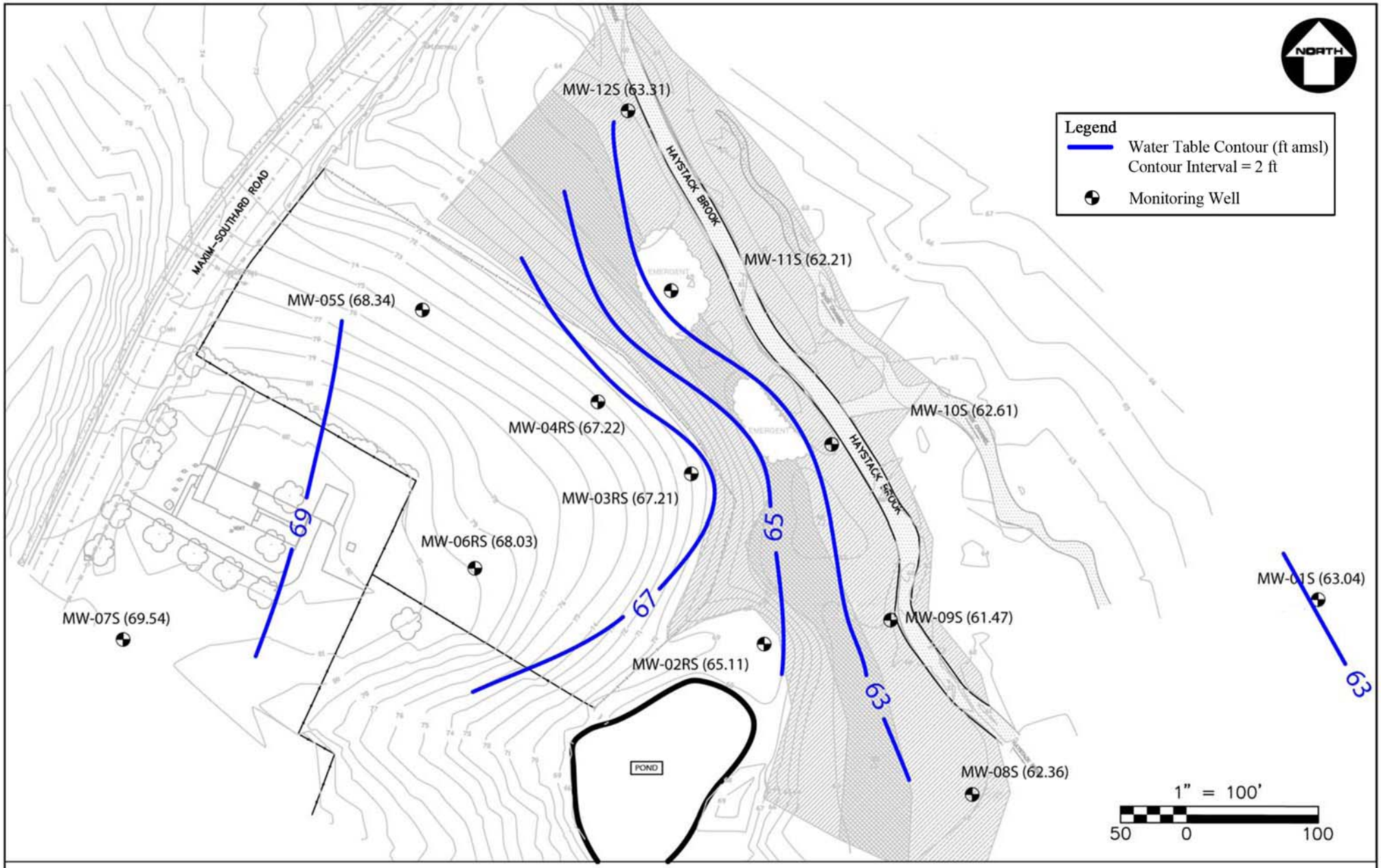


Figure 3-2
Water Table Contour Map
June 21, 2012
Zschiegner Refining Company Site
Howell, New Jersey

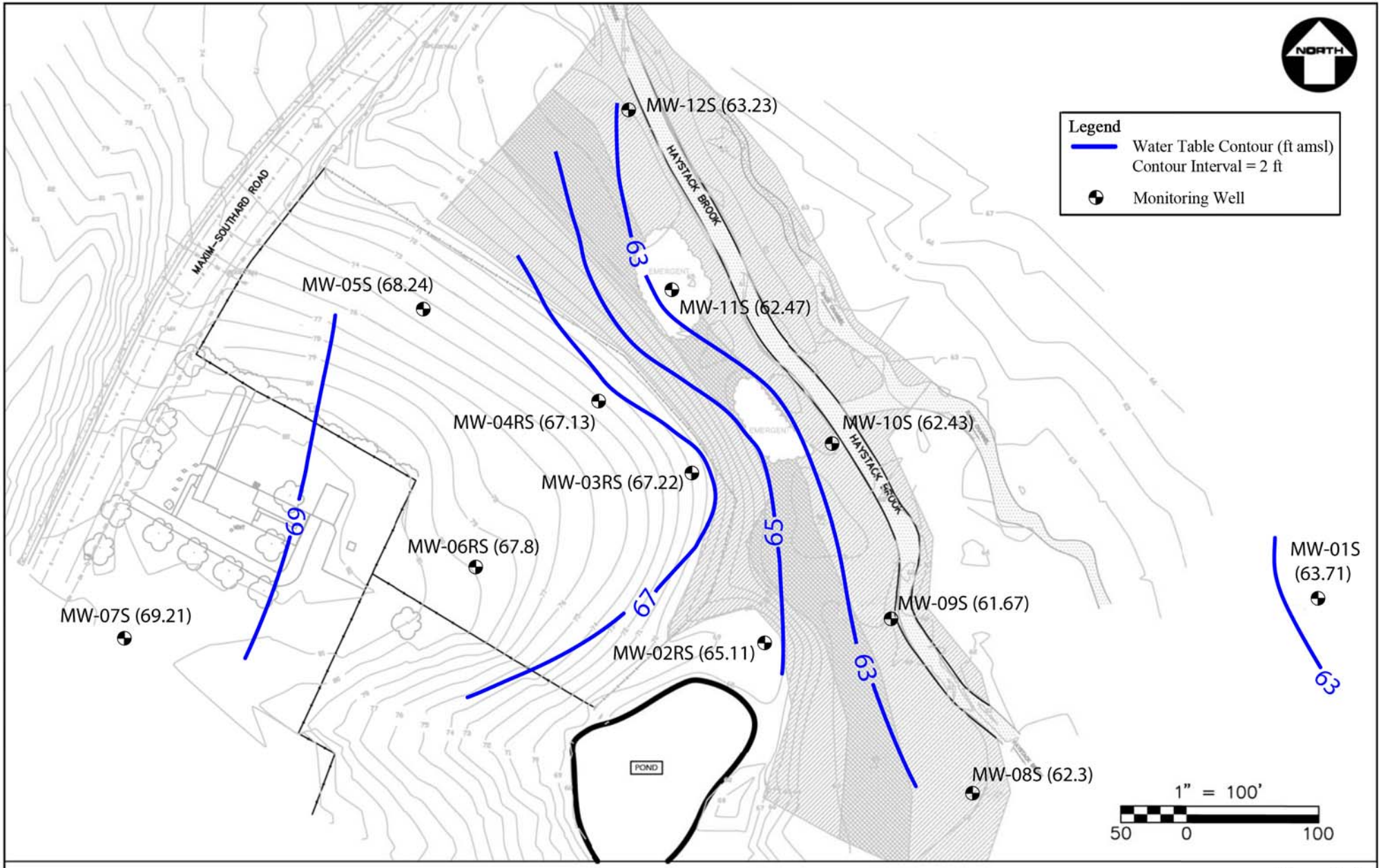


Figure 3-3
Water Table Contour Map
September 10, 2012
Zschiegner Refining Company Site
Howell, New Jersey

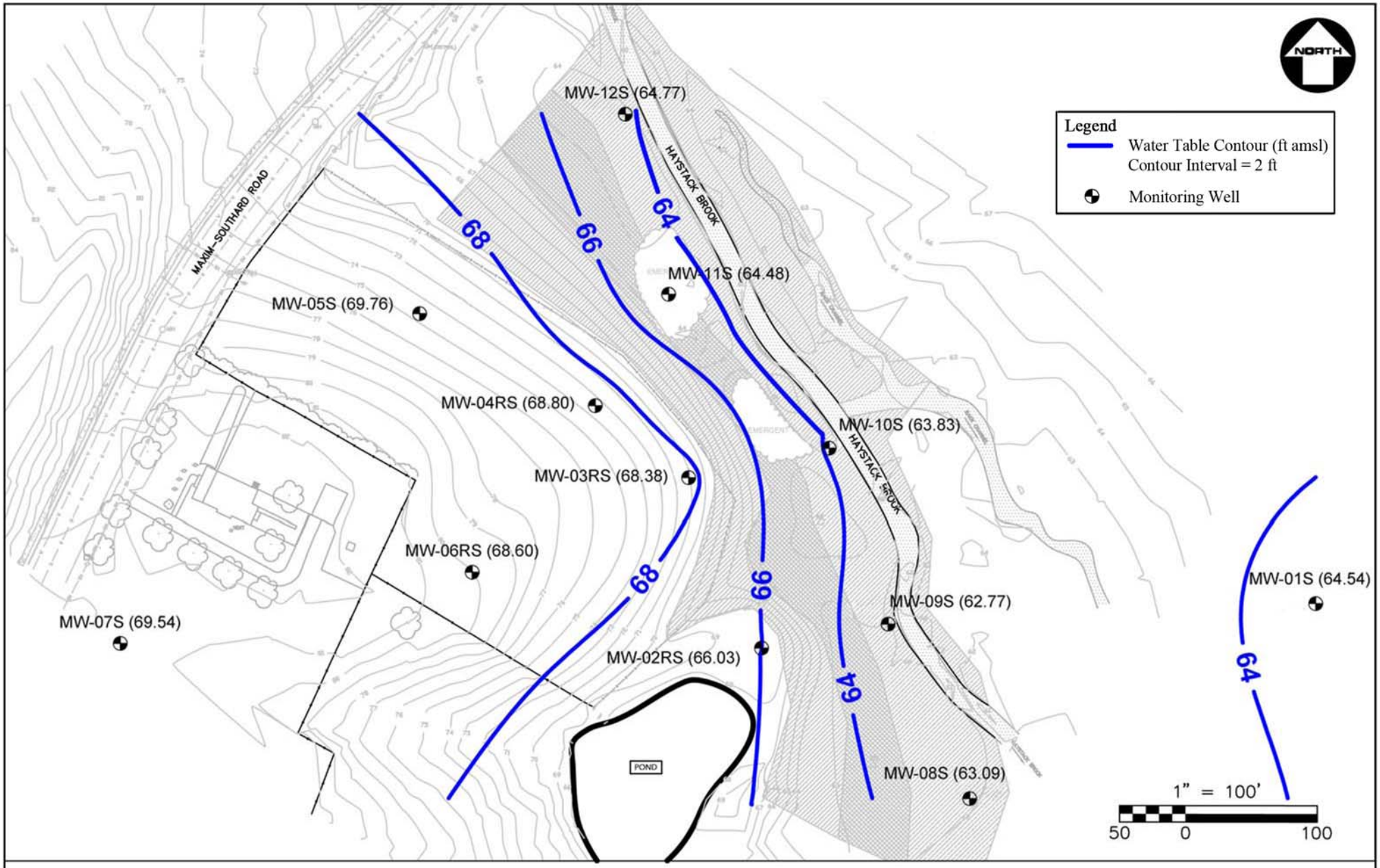
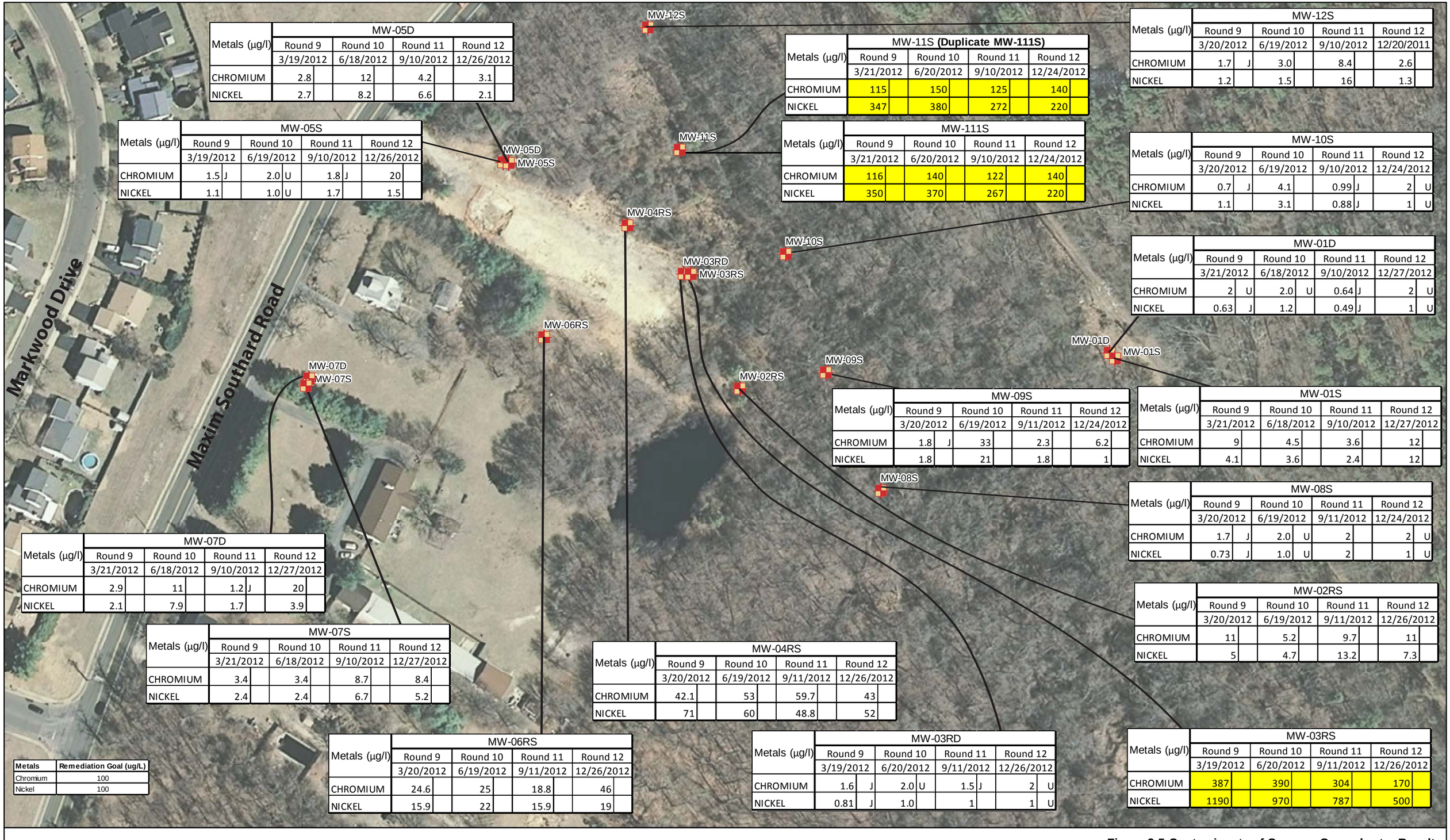


Figure 3-4
Water Table Contour Map
December 27, 2012
Zschiegner Refining Company Site
Howell, New Jersey



Metals (µg/l)	MW-05D							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/18/2012		9/10/2012		12/26/2012	
CHROMIUM	2.8		12		4.2		3.1	
NICKEL	2.7		8.2		6.6		2.1	

Metals (µg/l)	MW-05S							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/19/2012		9/10/2012		12/26/2012	
CHROMIUM	1.5	J	2.0	U	1.8	J	20	
NICKEL	1.1		1.0	U	1.7		1.5	

Metals (µg/l)	MW-11S **(Duplicate MW-111S)**							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/20/2012		9/10/2012		12/24/2012	
CHROMIUM	115		150		125		140	
NICKEL	347		380		272		220	

Metals (µg/l)	MW-111S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/20/2012		9/10/2012		12/24/2012	
CHROMIUM	116		140		122		140	
NICKEL	350		370		267		220	

Metals (µg/l)	MW-12S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/10/2012		12/20/2011	
CHROMIUM	1.7	J	3.0		8.4		2.6	
NICKEL	1.2		1.5		16		1.3	

Metals (µg/l)	MW-10S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/10/2012		12/24/2012	
CHROMIUM	0.7	J	4.1		0.99	J	2	U
NICKEL	1.1		3.1		0.88	J	1	U

Metals (µg/l)	MW-01D							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	2	U	2.0	U	0.64	J	2	U
NICKEL	0.63	J	1.2		0.49	J	1	U

Metals (µg/l)	MW-09S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/24/2012	
CHROMIUM	1.8	J	33		2.3		6.2	
NICKEL	1.8		21		1.8		1	

Metals (µg/l)	MW-01S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	9		4.5		3.6		12	
NICKEL	4.1		3.6		2.4		12	

Metals (µg/l)	MW-08S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/24/2012	
CHROMIUM	1.7	J	2.0	U	2		2	U
NICKEL	0.73	J	1.0	U	2		1	U

Metals (µg/l)	MW-07D							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	2.9		11		1.2	J	20	
NICKEL	2.1		7.9		1.7		3.9	

Metals (µg/l)	MW-07S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	3.4		3.4		8.7		8.4	
NICKEL	2.4		2.4		6.7		5.2	

Metals (µg/l)	MW-04RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	42.1		53		59.7		43	
NICKEL	71		60		48.8		52	

Metals (µg/l)	MW-02RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	11		5.2		9.7		11	
NICKEL	5		4.7		13.2		7.3	

Metals (µg/l)	MW-06RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	24.6		25		18.8		46	
NICKEL	15.9		22		15.9		19	

Metals (µg/l)	MW-03RD							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/20/2012		9/11/2012		12/26/2012	
CHROMIUM	1.6	J	2.0	U	1.5	J	2	U
NICKEL	0.81	J	1.0		1		1	U

Metals (µg/l)	MW-03RS							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/20/2012		9/11/2012		12/26/2012	
CHROMIUM	387		390		304		170	
NICKEL	1190		970		787		500	

Metals	Remediation Goal (ug/L)
Chromium	100
Nickel	100

Legend

monitoring well

J - estimate result value
U - non-detect
ug/L - microgram per Liter

1. Values detected in exceedence of remediation goals are highlighted.
2. Remediation goals for chromium and nickel set forth in the ROD (EPA, 2004).

N

0 30 60 120 Feet

Basemap: USGS 15cm Color Ortho Imagery (2007)
Source: ESRI ArcGIS Online
Coordinate System: NAD83 New York State Plane East FIPS 3101 Feet

Figure 3-5:Contaminants of Concern Groundwater Results
Zschiegner Refining Company Site
1442 Maxim Southard Road
Howell Township, New Jersey

CDM Smith

Figure 3-6
Trend Analysis - Contaminants of Concern Exceedances
Zschiegner Refining Company Site
Howell, New Jersey

Figure 3-6a

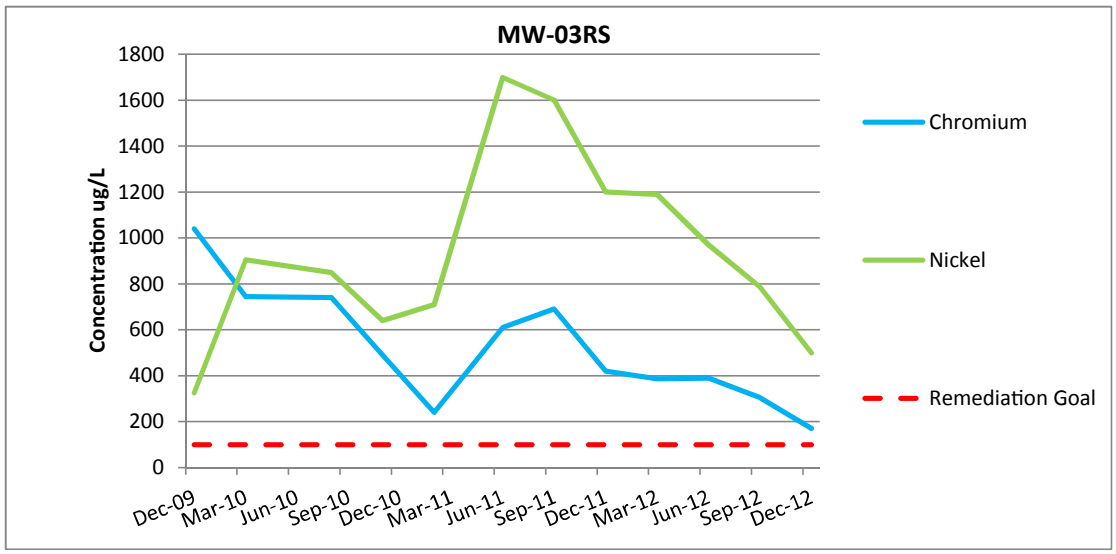


Figure 3-6b

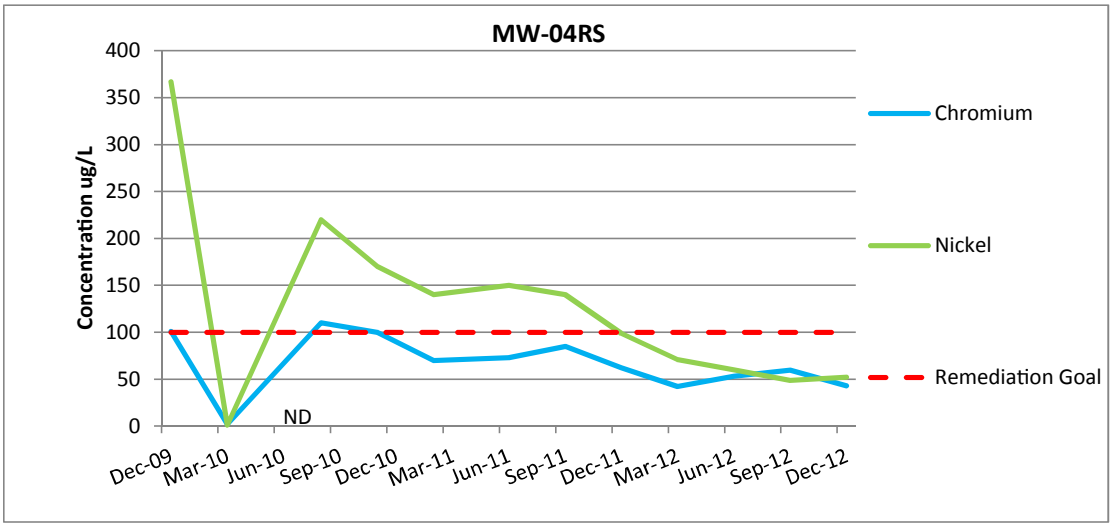
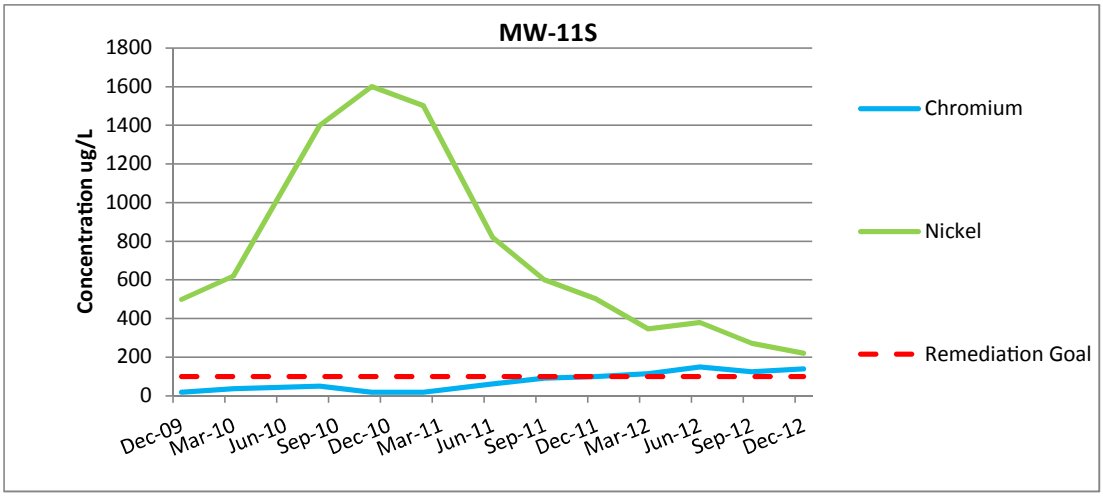
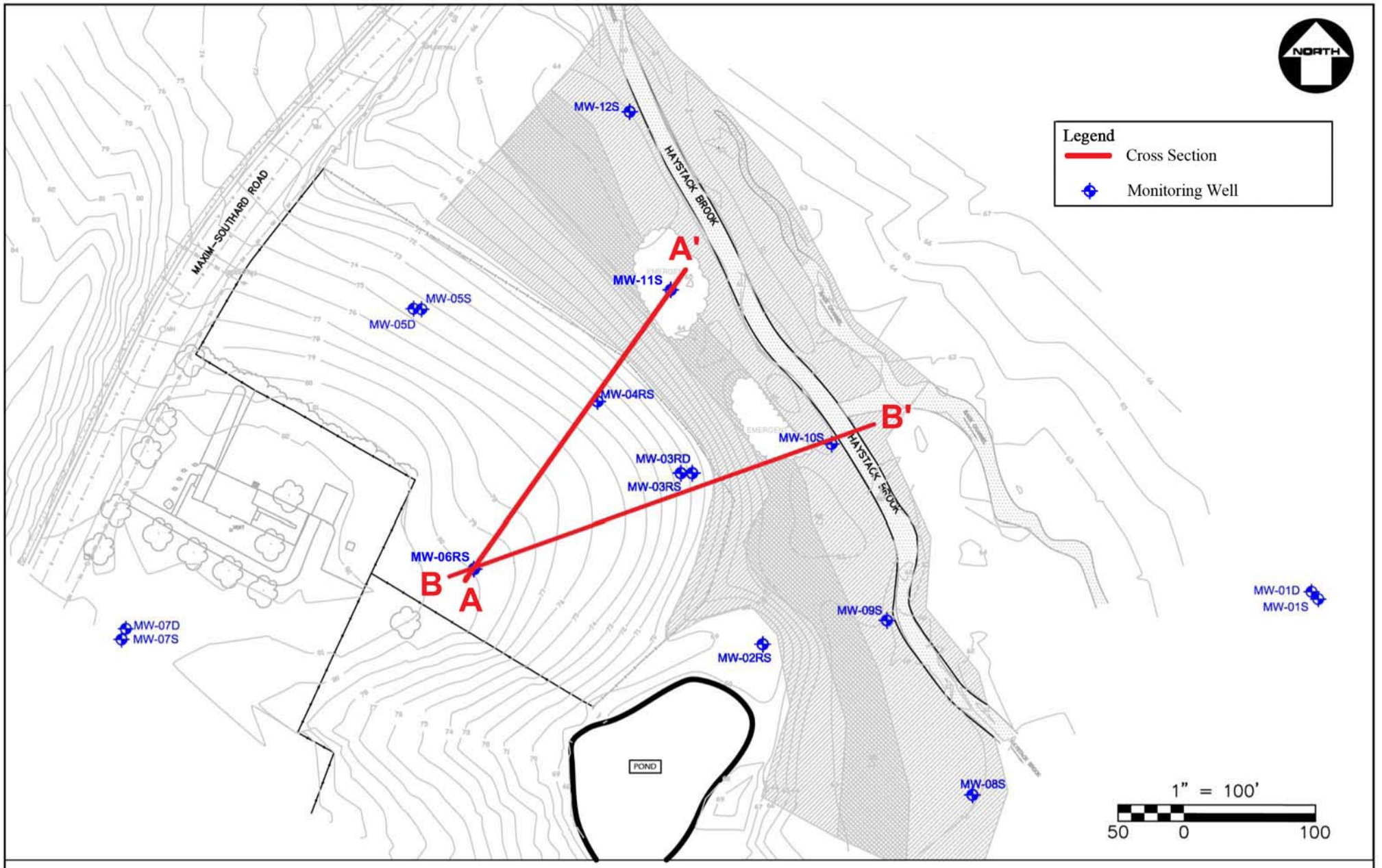


Figure 3-6c



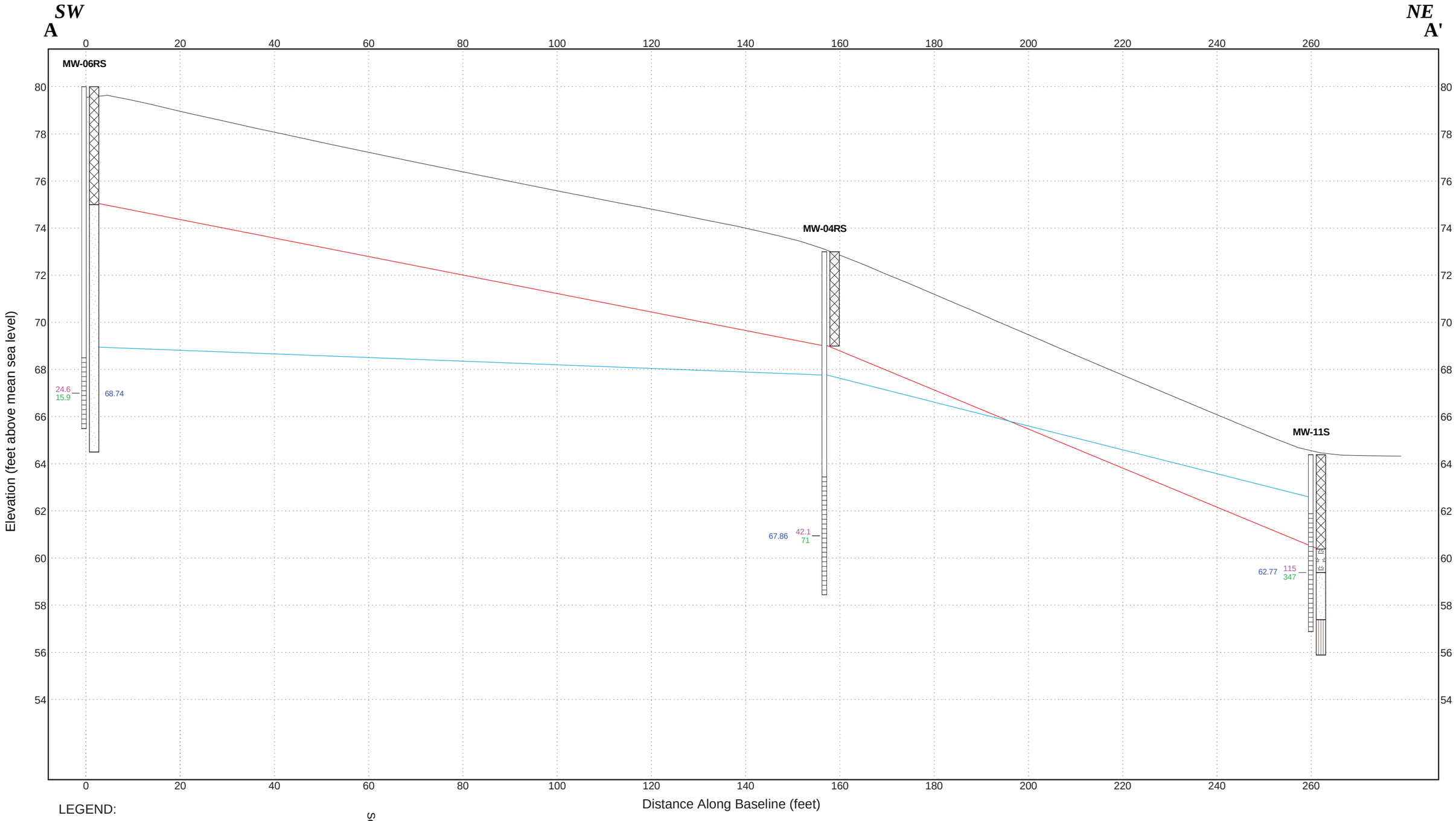
Notes: Remediation goals for chromium and nickel set forth in the ROD (EPA, 2004).
ND = non-detect

CDM Smith



CDM Smith

Figure 3-7
Cross Section Location Map
Zschiegner Refining Company Site
Howell, New Jersey



LEGEND:

- Fill (made ground)
- USCS Poorly-graded Sand
- USCS Silt
- USCS Peat
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: March 19, 2012

Chromium
Nickel
Groundwater Sample Results
All results in micrograms per liter

Horizontal Scale (feet): 0, 20

Vertical Scale (feet): 0, 4

Vertical Exaggeration: 5x

Figure 3-8
Cross Section A-A'
March 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

SW
B

NE
B'

MW-06RS

MW-03RD

MW-03RS

MW-10S

68.74
24.6
15.9

387
1190
67.82

62.61
0.7 J
1.1

68.31
1.6 J
0.81 J

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

LEGEND:

- Fill (made ground)
- USCS Silt
- USCS Poorly-graded Sand
- USCS Peat
- USCS Clay
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: December 19, 2011

Chromium
Nickel
Groundwater Sample Results
All results in micrograms per liter

J - estimated result value

Horizontal Scale (feet): 0, 25

Vertical Exaggeration: 2.5x

Figure 3-9
Cross Section B-B'
March 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

SW A

NE A'

MW-06RS

MW-04RS

MW-11S

25
22
68.03

67.22
53
60

62.21
150
380

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

Vertical Exaggeration: 5x

LEGEND:

- Fill (made ground)
- USCS Poorly-graded Sand
- USCS Peat
- USCS Silt
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

Horizontal Scale (feet)

Vertical Scale (feet)

CDM Smith

Chromium
Nickel

Groundwater Sample Results
All results in micrograms per liter

27.89 Water Level Elevation (feet above mean sea level)
Date: June 21, 2012

Figure 3-10
Cross Section A-A'
June 2012
Zschiegner Refining Company Site
Howell, NJ

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/08/17 REV.

SW
B

NE
B'

MW-06RS

MW-03RD

MW-03RS

MW-10S

68.03
25
22

390
970
67.21

62.61
4.1
3.1

67.65
2 U
1

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

LEGEND:

- Fill (made ground)
- USCS Silt
- USCS Poorly-graded Sand
- USCS Peat
- USCS Clay
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: June 21, 2012

Chromium
Nickel
Groundwater Sample Results
All results in micrograms per liter
U - non-detect

Horizontal Scale (feet)

Vertical Exaggeration: 2.5x

Figure 3-11
Cross Section B-B'
June 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

SW A

NE A'

MW-06RS

MW-04RS

MW-11S

18.8
15.9

67.80

67.13

59.7
48.8

62.47

125
272

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

LEGEND:

- Fill (made ground)
- USCS Poorly-graded Sand
- USCS Silt
- USCS Peat
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: September 10, 2012

Chromium
Nickel
Groundwater Sample Results
All results in micrograms per liter

Horizontal Scale (feet)

Vertical Scale (feet)

Vertical Exaggeration: 5x

Figure 3-12
Cross Section A-A'
September 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

SW

B

NE

B'

MW-06RS

MW-03RD

MW-03RS

MW-10S

67.80 18.8 15.9

304 787 67.22

62.43 .99 J .88 J

67.69 1.5 J 1

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

LEGEND:

- Fill (made ground)
- USCS Silt
- USCS Poorly-graded Sand
- USCS Peat
- USCS Clay
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: September 10, 2012

Chromium
Nickel

Groundwater Sample Results
All results in micrograms per liter

J - estimated result value

Horizontal Scale (feet): 0, 25

0, 10

Vertical Exaggeration: 2.5x

Figure 3-13
Cross Section B-B'
September 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

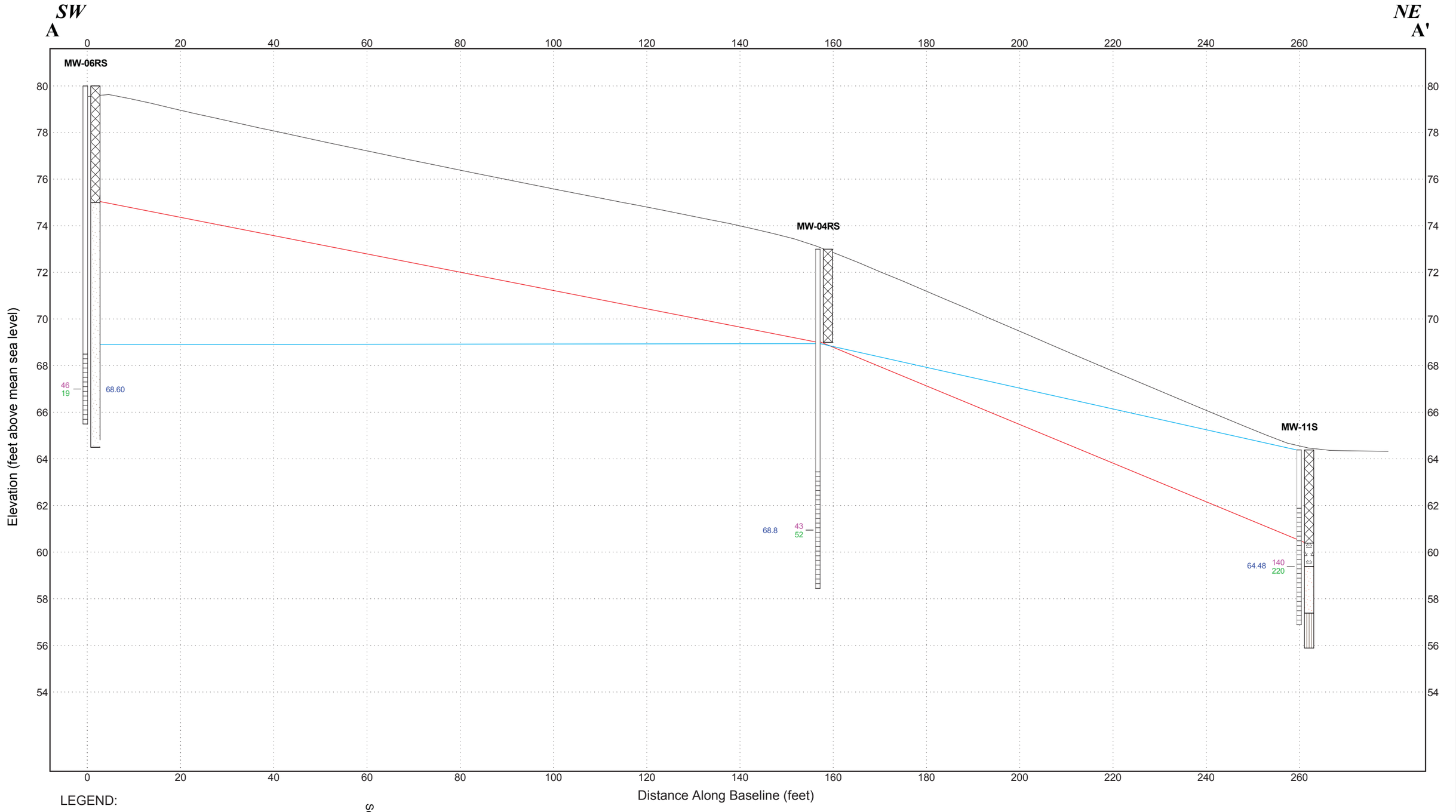


Figure 3-14
Cross Section A-A'
December 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.

SW B

NE B'

MW-06RS

MW-03RD MW-03RS

MW-10S

68.60 46 19

170 500 68.38

63.83 2 U 1 U

68.59 2 U 1 U

Elevation (feet above mean sea level)

Distance Along Baseline (feet)

LEGEND:

- Fill (made ground)
- USCS Poorly-graded Sand
- USCS Silt
- USCS Peat
- USCS Clay
- Screened Interval
- Interpolated ground surface elevation
- Interpolated water table surface
- Interpolated lower limit of fill placed during remediation

27.89 Water Level Elevation (feet above mean sea level)
Date: December 27, 2012

Chromium
Nickel
Groundwater Sample Results
All results in micrograms per liter
U - non detect

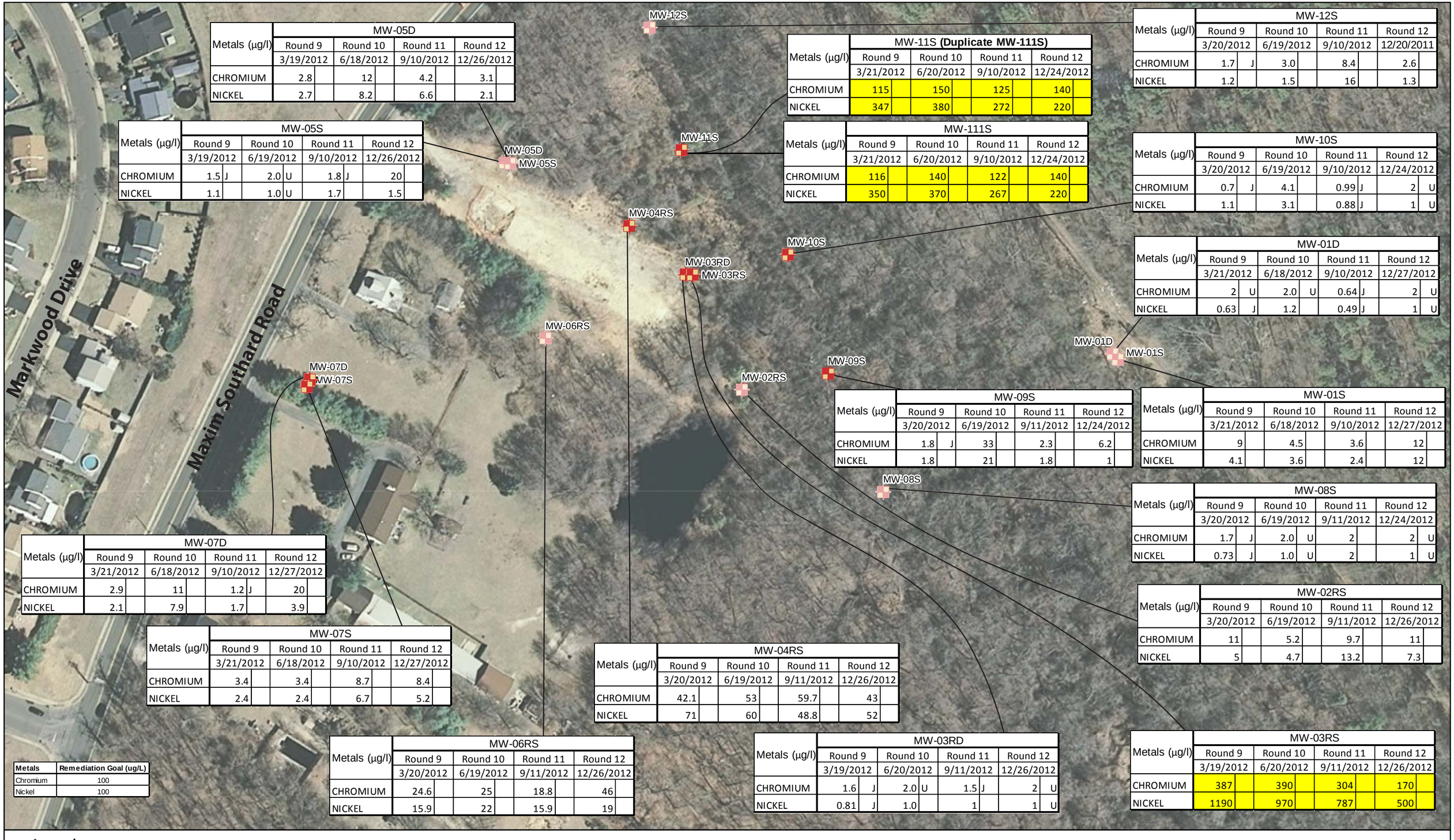
Horizontal Scale (feet) 0 25

Vertical Exaggeration: 2.5x

Figure 3-15
Cross Section B-B'
December 2012
Zschiegner Refining Company Site
Howell, NJ

CDM Smith

STANDARD CROSS SECTION: Z-SITE Z_SITE.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 12/04/26 REV.



Metals (µg/l)	MW-05D							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/18/2012		9/10/2012		12/26/2012	
CHROMIUM	2.8		12		4.2		3.1	
NICKEL	2.7		8.2		6.6		2.1	

Metals (µg/l)	MW-05S							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/19/2012		9/10/2012		12/26/2012	
CHROMIUM	1.5	J	2.0	U	1.8	J	20	
NICKEL	1.1		1.0	U	1.7		1.5	

Metals (µg/l)	MW-11S **(Duplicate MW-111S)**							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/20/2012		9/10/2012		12/24/2012	
CHROMIUM	115		150		125		140	
NICKEL	347		380		272		220	

Metals (µg/l)	MW-111S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/20/2012		9/10/2012		12/24/2012	
CHROMIUM	116		140		122		140	
NICKEL	350		370		267		220	

Metals (µg/l)	MW-12S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/10/2012		12/20/2011	
CHROMIUM	1.7	J	3.0		8.4		2.6	
NICKEL	1.2		1.5		16		1.3	

Metals (µg/l)	MW-10S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/10/2012		12/24/2012	
CHROMIUM	0.7	J	4.1		0.99	J	2	U
NICKEL	1.1		3.1		0.88	J	1	U

Metals (µg/l)	MW-01D							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	2	U	2.0	U	0.64	J	2	U
NICKEL	0.63	J	1.2		0.49	J	1	U

Metals (µg/l)	MW-09S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/24/2012	
CHROMIUM	1.8	J	33		2.3		6.2	
NICKEL	1.8		21		1.8		1	

Metals (µg/l)	MW-01S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	9		4.5		3.6		12	
NICKEL	4.1		3.6		2.4		12	

Metals (µg/l)	MW-08S							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/24/2012	
CHROMIUM	1.7	J	2.0	U	2		2	U
NICKEL	0.73	J	1.0	U	2		1	U

Metals (µg/l)	MW-07D							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	2.9		11		1.2	J	20	
NICKEL	2.1		7.9		1.7		3.9	

Metals (µg/l)	MW-07S							
	Round 9		Round 10		Round 11		Round 12	
	3/21/2012		6/18/2012		9/10/2012		12/27/2012	
CHROMIUM	3.4		3.4		8.7		8.4	
NICKEL	2.4		2.4		6.7		5.2	

Metals (µg/l)	MW-04RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	42.1		53		59.7		43	
NICKEL	71		60		48.8		52	

Metals (µg/l)	MW-02RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	11		5.2		9.7		11	
NICKEL	5		4.7		13.2		7.3	

Metals (µg/l)	MW-06RS							
	Round 9		Round 10		Round 11		Round 12	
	3/20/2012		6/19/2012		9/11/2012		12/26/2012	
CHROMIUM	24.6		25		18.8		46	
NICKEL	15.9		22		15.9		19	

Metals (µg/l)	MW-03RD							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/20/2012		9/11/2012		12/26/2012	
CHROMIUM	1.6	J	2.0	U	1.5	J	2	U
NICKEL	0.81	J	1.0		1		1	U

Metals (µg/l)	MW-03RS							
	Round 9		Round 10		Round 11		Round 12	
	3/19/2012		6/20/2012		9/11/2012		12/26/2012	
CHROMIUM	387		390		304		170	
NICKEL	1190		970		787		500	

Metals	Remediation Goal (ug/L)
Chromium	100
Nickel	100

Legend

- monitoring well (recommend continue sampling)
- monitoring well (recommend discontinue sampling)

J - estimate result value
U - non-detect
ug/L - microgram per Liter

1. Values detected in exceedence of remediation goals are highlighted.
2. Remediation goals for chromium and nickel set forth in the ROD (EPA, 2004).

N

0 30 60 120 Feet

Basemap: USGS 15cm Color Ortho Imagery (2007)
Source: ESRI ArcGIS Online
Coordinate System: NAD83 New York State Plane East FIPS 3101 Feet

Figure 4-1: Proposed Monitoring Wells for Semi-annual Sampling
Zschiegner Refining Company Site
1442 Maxim Southard Road
Howell Township, New Jersey

CDM Smith

Tables

Table 2-1
Summary of Monitoring Well Construction and Groundwater Levels
Zschiegner Refining Company Site
Howell Township, New Jersey

Well ID	Surface Elevation (ft amsl)	Measurement Point Elevation (ft amsl)	Total Depth of Well (feet bgs)	Coordinates		Well Borehole Diameter (inches)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Top of Screened Interval (ft amsl)	Bottom of Screened Interval (ft amsl)	Groundwater Elevation (ft amsl)			
				Northing[1]	Easting[1]						Round 9 3/22/2012	Round 10 6/21/2012	Round 11 9/10/2012	Round 12 12/27/2012
MW-01D	NA	66.85	55.50	477793.88	576792.13	16	45.50	55.50	21.35	11.35	66.85	66.30	66.43	66.85
MW-01S	NA	66.92	11.00	477787.60	576797.94	10	6.00	11.00	60.92	55.92	63.87	63.04	63.71	64.54
MW-02RS[2,3]	68.00	NA	13.52	477753.66	576376.13	8	8.52	13.52	61.48	56.48	65.50	65.11	65.11	66.03
MW-03RS	71.25	72.71	15.21	477882.77	576320.66	8	9.96	14.96	62.75	57.75	67.82	67.21	67.22	68.38
MW-03RD[2]	71.25	73.25	61.00	477882.86	576312.70	12	50.00	60.00	23.25	13.25	68.31	67.65	67.69	68.59
MW-04RS	73.00	75.09	14.68	477937.58	576249.61	8	9.55	14.55	65.54	60.54	67.86	67.22	67.13	68.80
MW-05D	NA	76.68	65.50	478008.15	576109.91	16	54.00	64.00	22.68	12.68	68.90	68.25	68.26	69.11
MW-05S	NA	76.49	14.00	478007.68	576115.91	10	9.00	14.00	67.49	62.49	69.03	68.34	68.24	69.76
MW-06RS	80.00	81.71	16.62	477811.48	576155.91	8	12.62	16.62	69.09	65.09	68.74	68.03	67.80	68.60
MW-07D	81.75	81.39	70.76	477765.37	575891.33	16	60.76	70.76	20.63	10.63	69.65	68.97	68.77	69.49
MW-07S	81.75	81.34	17.00	477757.19	575888.08	10	12.00	17.00	69.34	64.34	70.02	69.54	69.21	69.54
MW-08S	62.31	64.49	8.04	477639.10	576534.58	8	2.82	7.82	61.67	56.67	62.36	61.96	62.30	63.09
MW-09S[3]	63.04	NA	8.50	477772.01	576472.50	8	2.50	7.50	62.54	57.54	61.79	61.47	61.67	62.77
MW-10S	63.34	65.70	7.92	477905.21	576427.56	8	2.70	7.70	63.00	58.00	62.61	62.19	62.43	63.83
MW-11S[3]	64.39	NA	8.50	478022.44	576305.40	8	2.50	7.50	63.89	58.89	61.42	60.86	61.12	64.48
MW-12S	64.86	67.24	7.82	478159.53	576272.48	8	2.60	7.60	64.64	59.64	63.31	62.85	63.23	64.77

Notes:

1 - Coordinates based on Horizontal Datum - New Jersey NAD 1983

2 - Replacement well specifications are based on construction logs for original wells installed during the Remedial Investigation (RI). CDM Smith requested, but did not receive well construction logs from the previous contractor.

3 - Measuring point elevation based on assumed inner casing elevation of 2 feet above surface elevation. CDM Smith requested, but did not receive well construction logs from the previous contractor.

Acronyms:

amsl - above mean sea level

bgs - below ground surface

ID - identification

ft - feet

NA - not available

NAD - North American Datum

Table 3-1
Quarterly Groundwater Results
Zschiegner Refining Company Site
Howell Township, New Jersey

Monitoring Well Location			MW-01D				MW-01S				MW-02RS				MW-03RD			
Sample Identification			MW-01D-R9	MW-01D-R10	MW-01D-R11	MW-01D-R12	MW-01S-R9	MW-01S-R10	MW-01S-R11	MW-01S-R12	MW-02RS-R9	MW-02RS-R10	MW-02RS-R11	MW-02RS-R12	MW-03RD-R9	MW-03RD-R10	MW-03RD-R11	MW-03RD-R12
Sample Date			3/21/2012	6/18/2012	9/10/2012	12/27/2012	3/21/2012	6/18/2012	9/10/2012	12/27/2012	3/20/2012	6/19/2012	9/11/2012	12/26/2012	3/19/2012	6/20/2012	9/11/2012	12/26/2012
Analyzed Compound	**Criteria[2]**	**Unit**																
ALUMINUM	200	µg/L	152	85 K	16.1 J	110	**542**	78	26.8	**230**	**1200**	**810**	**8980**	**4300**	153	71	27	76
ANTIMONY	6	µg/L	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U
ARSENIC	0.02	µg/L	**0.35**	**0.34**	**0.64 J**	**0.48**	**0.78**	**0.28**	**0.59 J**	**0.66**	**0.25**	**2**	**6.5 J**	**4.5**	**0.16**	**0.14**	**0.7 J**	**0.11**
BARIUM	6,000	µg/L	23.9	24	25.8	21	36.8	33	34	34	2.8 J	2.4	2.6 J	8	42	34	35	32
BERYLLIUM	1	µg/L	0.5 J	1 U	0.54 J	1 U	1 U	1 U	1 U	1 U	0.079 J	1 U	0.31 J	1 U	1 U	1 U	1 U	1 U
CADMIUM	4	µg/L	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U	0.38	1 U	0.25 U	1 U	0.25 U	1 U
CALCIUM	NA	µg/L	7940	8500	9100	8500	2480	2700	2930	2800	21300	17000	11900	44000	5680	6300	6360	6100
CHROMIUM	100	µg/L	2 U	2 U	0.64 J	2 U	9	4.5	3.6	12	11	5.2	9.7	11	1.6 J	2 U	1.5 J	2 U
COBALT	100	µg/L	0.083 J	1 U	1 U	1 U	0.14 J	1 U	1 U	1 U	0.27 J	1 U	1 U	1 U	0.12 J	1 U	1 U	1 U
COPPER	1,300	µg/L	2.2	5.5	1.7 J	2.9	4.7	11	11.5	10	64.2	33	3.2	160	1.4 J	4.1	2.7	1.3
IRON	300	µg/L	**18400**	**12000**	**14200**	**11000**	**24300**	**9100**	**11300**	**14000**	**2710**	**1100**	**2600**	**8000**	**1800**	**2500**	**2560**	**1600**
LEAD	5	µg/L	1 U	1 U	0.38 J	1 U	1.5	**5.1**	2.5	1	1.5	4.4	1.6	2.9	1 U	1 U	0.41 J	1 U
MAGNESIUM	NA	µg/L	1770	1800	1960	1800	655	650	678	630	1100	650	286 J	5700	1460	1400	1470	1400
MANGANESE	50	µg/L	37.1	36	39.7	27	32.1	31	32.5	32	45.5	19	19.3	**440**	23.6	19	22.2	20
MOLYBDENUM	40	µg/L		1 U		1 U		1 U		2.2		4		7.7		1 U		1 U
NICKEL	100	µg/L	0.63 J	1.2	0.49 J	1 U	4.1	3.6	2.4	12	5	4.7	13.2	7.3	0.81 J	1	1	1 U
POTASSIUM	NA	µg/L	2770	2800 J	3340	2900	1470	1400	1790	1600	62500	46000	58800	59000	2630	2900	3010	2800
SELENIUM	40	µg/L	5 U	1 U	5 U	1 U	5 U	1 U	5 U	1 U	0.76 J	1.6	1.9 J	2.6	5 U	1 U	5 U	1 U
SILVER	40	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SODIUM	50000	µg/L	4790	5100	500 U	5000	3560	3700	3290	3700	35200	32000	32400	30000	3350	3400	2880	3100
THALLIUM	0.5	µg/L	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U
VANADIUM	60	µg/L	2 J	1 U	5 U	1	5.1	1.1	5 U	2.2	4.3 J	3.7	22.1	7.6	2.7 J	1 U	5 U	1 U
ZINC	2000	µg/L	5.3	23	15.3 J	10	9.5	34	48.9	27	7.4 J	8.1	14	14	6.5	21	8.6	5
HARDNESS	NA	mg/L	26.8	28.5	30.8	28.5	8.89	9.44	10.1	9.48	57.8	44.4	30.9	133	20.2	21.6	21.9	21.1
ORGANIC CARBON, TOT.	NA	mg/L	1	1	1 U	1.3	2.9	1.7	2.4	2	10	9.9	24	15	ND	1 U	1 U	1 U
RESIDUE, FILTERABLE (TDS)	NA	mg/L	62	100	98	96	38	86	34	42	300	310	370	370	50	110	59	43
RESIDUE, NON-FILTERABLE (TSS)	NA	mg/L	23	23	25	10 U	77	32	36	45	10	10 U	10	27	ND	12	11	10
ORGANIC CARBON, DISSOLVED	NA	mg/L	1.9	1.6	2.1	1.5	1.3	3.1	2.7	1 U	11	11	23	14	ND	1 U	1 U	1 U

Notes:

1. Values detected in exceedence of screening criteria are highlighted and bolded; rejected values are highlighted in red.

2. Criteria for Chromium and Nickel are remediation goals set forth in the ROD (EPA, 2004). All other criteria based on New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C).

Acronyms:

bgs - below ground surface
J - estimate result value
K - estimate result, biased high
mg/L - milligram per Liter
NA - not applicable
ND - not detected
R - rejected result
U - non-detect
µg/L - microgram per Liter
TDS - Total Dissolved Solids
TSS - Total Suspended Solids
TOT - total

Table 3-1
Quarterly Groundwater Results
Zschiegner Refining Company Site
Howell Township, New Jersey

Monitoring Well Location			MW-03RS				MW-04RS				MW-05D				MW-05S			
Sample Identification			MW-03RS-R9	MW-03RS-R10	MW-03RS-R11	MW-03RS-R12	MW-04RS-R9	MW-04RS-R10	MW-04RS-R11	MW-04RS-R12	MW-05D-R9	MW-05D-R10	MW-05D-R11	MW-05D-R12	MW-05S-R9	MW-05S-R10	MW-05S-R11	MW-05S-R12
Sample Date			3/19/2012	6/20/2012	9/11/2012	12/26/2012	3/20/2012	6/19/2012	9/11/2012	12/26/2012	3/19/2012	6/18/2012	9/10/2012	12/26/2012	3/19/2012	6/19/2012	9/10/2012	12/26/2012
Analyzed Compound	**Criteria[2]**	**Unit**																
ALUMINUM	200	µg/L	**833**	**1000**	**552**	**360**	**431**	**260**	112	**250**	55.6	**420**	30.8	180	62	30 U	13.5 J	32
ANTIMONY	6	µg/L	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U
ARSENIC	0.02	µg/L	0.1 U	**0.49**	**0.64 J**	**0.73**	0.1 U	**0.33**	**0.47 J**	**0.35**	**0.13**	**1.9**	**0.7 J**	**0.54**	**0.27**	**0.21**	**0.56 J**	**0.38**
BARIUM	6,000	µg/L	27.2	36	31.7	27	28.7	28	29.2	24	74	74	71.6	70	15.7	15	14.5	13
BERYLLIUM	1	µg/L	0.86 J	**1.1**	1	1 U	1 U	1 U	1 U	1 U	0.24 J	1 U	0.35 J	1 U	1 U	1 U	1 U	1 U
CADMIUM	4	µg/L	**5.6**	**5.9**	**4.3**	1.8	1.1	1	1.2	1 U	0.24 J	1 U	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U
CALCIUM	NA	µg/L	24200	25000	30200	38000	13900	14000	15900	15000	4500	5200	5870	4900	8950	9600	9200	8700
CHROMIUM	100	µg/L	**387**	**390**	**304**	**170**	42.1	53	59.7	43	2.8	12	4.2	3.1	1.5 J	2 U	1.8 J	20
COBALT	100	µg/L	7.3	7.3	7	7.1	0.93 J	1 U	0.96 J	1 U	0.74 J	1 U	0.34 J	1 U	0.16 J	1 U	1 U	1 U
COPPER	1,300	µg/L	**1890**	**1700**	**1450**	840	91.8	120	76.9	69	1.9 J	6	4.6	2.4	2.9	9.1	6.6	7.4
IRON	300	µg/L	194 J	99	155 J	**2200**	**418**	**310**	40.5 J	**370**	**1310**	**5400**	**3470**	**3600**	149 J	68	79.2 J	**800**
LEAD	5	µg/L	1.8	1.6	1.4	1 U	3	**6.1**	0.91 J	2.9	1 U	2.5	0.35 J	1 U	1 U	1.7	0.27 J	1 U
MAGNESIUM	NA	µg/L	3530	3600	3270	3600	3380	3200	3680	3400	1290	1500	1480	1400	1720	1800	1790	1600
MANGANESE	50	µg/L	**71.7**	**70**	**76.6**	**150**	27.8	25	30	25	30.8	36	37.8	33	5.1	3.5	4	5.9
MOLYBDENUM	40	µg/L		1 U		1 U		1 U		1 U		1.9		1 U		1 U		1 U
NICKEL	100	µg/L	**1190**	**970**	**787**	**500**	71	60	48.8	52	2.7	8.2	6.6	2.1	1.1	1 U	1.7	1.5
POTASSIUM	NA	µg/L	2940	3400	5110	8000	5520	6100	9730	6900	2560	2400	2600	2700	1700	2000	2200	1700
SELENIUM	40	µg/L	1.1 J	2.4	5 U	1	0.65 J	1.4	5 U	1.1	5 U	1 U	5 U	1 U	0.81 J	1.3	1.3 J	2
SILVER	40	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SODIUM	50000	µg/L	15000	18000	14300	16000	27200	25000	11700	21000	3840	3800	3380	4000	42700	47000	29500	31000
THALLIUM	0.5	µg/L	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U
VANADIUM	60	µg/L	5 U	1 U	5 U	1 U	5 U	1 U	5 U	1 U	2.4 J	1.8	5 U	1 U	1.2 J	1 U	5 U	1 U
ZINC	2000	µg/L	1020	1100	796	400	183	170	181	140	11.1	23	26	15	5.9	22	26.5	29
HARDNESS	NA	mg/L	75	77.6	88.9	110	48.6	48.7	54.9	51.5	16.5	19.3	20.8	17.9	29.4	31.2	30.3	28.3
ORGANIC CARBON, TOT.	NA	mg/L	3.3	3.5	3.6	5.3	2.7	2	2.1	2.1	ND	1 U	1 U	1 U	2.4	1.9	1.7	2.3
RESIDUE, FILTERABLE (TDS)	NA	mg/L	180	210	230	190	180	190	150	130	53	76	49	33	210	210	160	130
RESIDUE, NON-FILTERABLE (TSS)	NA	mg/L	ND	10 U	10 U	11	ND	10 U	10 U	10 U	ND	32	37	21	ND	10 U	10 U	10 U
ORGANIC CARBON, DISSOLVED	NA	mg/L	3.3	4.9	3.9	5.6	2.5	2.3	2.1	2.4	ND	1.3	1 U	1.2	2.5	2.7	1.9	2.5

Notes:

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2. Criteria for Chromium and Nickel are remediation goals set forth in the ROD (EPA, 2004). All other criteria based on New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C).

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Table 3-1
Quarterly Groundwater Results
Zschiegner Refining Company Site
Howell Township, New Jersey

Monitoring Well Location			MW-06RS								MW-07D								MW-07S								MW-08S							
Sample Identification			MW-06RS-R9		MW-06RS-R10		MW-06RS-R11		MW-06RS-R12		MW-07D-R9		MW-07D-R10		MW-07D-R11		MW-07D-R12		MW-07S-R9		MW-07S-R10		MW-07S-R11		MW-07S-R12		MW-08S-R9		MW-08S-R10		MW-08S-R11		MW-08S-R12	
Sample Date			3/20/2012		6/19/2012		9/11/2012		12/26/2012		3/21/2012		6/18/2012		9/10/2012		12/27/2012		3/21/2012		6/18/2012		9/10/2012		12/27/2012		3/20/2012		6/19/2012		9/11/2012		12/24/2012	
Analyzed Compound	Criteria[2]	Unit																																
ALUMINUM	200	µg/L	**351**		**210**		**275**		**600**		**232**		120		23.9		180		53.9		99		46.8		90		**309**		54		30.5		170	
ANTIMONY	6	µg/L	2	U	1	U	2	U	1	U	2	U	1	U	2	U	1	U	2	U	1	U	2	U	1	U	2	U	1	U	2	U	1	U
ARSENIC	0.02	µg/L	0.1	U	**0.63**		**0.73**	J	**1.2**		**0.26**		**0.43**		**0.34**	R	**0.49**		0.1	U	**0.24**		**0.47**	J	**0.26**		**0.1**		**0.21**		**0.64**	J	**0.28**	
BARIUM	6,000	µg/L	21		19		18.5		20		56.5		50		53.3		43		10.5		9.5		9.2	J	9.4		38.4		36		34.4		33	
BERYLLIUM	1	µg/L	1	U	1	U	1	U	1	U	0.22	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
CADMIUM	4	µg/L	0.25	U	1	U	0.25	U	1	U	0.25	U	1	U	0.25	U	1	U	0.25	U	1	U	0.25	U	1	U	0.14	J	1	U	0.25	U	1	U
CALCIUM	NA	µg/L	28800		34000		35200		28000		6520		6400		5410		6500		3870		4000		4130		3800		4440		4300		4300		4000	
CHROMIUM	100	µg/L	24.6		25		18.8		46		2.9		11		1.2	J	20		3.4		3.4		8.7		8.4		1.7	J	2	U	2		2	U
COBALT	100	µg/L	0.87	J	1	U	1.1		1.2		0.16	J	1	U	1	U	1	U	0.26	J	1	U	0.31	J	1	U	0.052	J	1	U	1	U	1	U
COPPER	1,300	µg/L	64.3		120		123		150		4.6		8.7		3.8		8.7		8.8		22		11.5		13		3		8.1		2.1		3.4	
IRON	300	µg/L	**415**		270		107	J	**1600**		**1340**		**1300**		**1160**		**2300**		79.7	J	240		120	J	220		**3030**		**3200**		**3370**		**3400**	
LEAD	5	µg/L	1	U	1	U	1.6		1	U	1.2		1	U	0.21	J	1	U	1	U	1	U	0.55	J	2.1		1.9		1	U	0.96	J	1.8	
MAGNESIUM	NA	µg/L	5300		6200		6830		5300		1200		1300		1290		1500		2110		2100		2220		2000		1350		1200		1220		1200	
MANGANESE	50	µg/L	17.1		15		17.2		20		18.7		23		23.6		27		1.8		1.6		2.5		2.1		**56**		40		32.9		43	
MOLYBDENUM	40	µg/L			1.1				1	U			1.5				1	U			1	U			1	U			1	U			1	U
NICKEL	100	µg/L	15.9		22		15.9		19		2.1		7.9		1.7		3.9		2.4		2.4		6.7		5.2		0.73	J	1	U	2		1	U
POTASSIUM	NA	µg/L	7080		8900		9960		8200		7220		6900		6470		8100		2180		2200		2660		2300		1730		1800		2070		1700	
SELENIUM	40	µg/L	0.82	J	2.2		5	U	2.6		5	U	1	U	5	U	1	U	0.54	J	1.3		5	U	1.1		5	U	1	U	5	U	1	U
SILVER	40	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
SODIUM	50000	µg/L	26900		20000		13900		19000		4640		4800		3760		5500		8280		8000		6710		6000		3720		3800		3140		3700	
THALLIUM	0.5	µg/L	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U	0.24	U	0.5	U
VANADIUM	60	µg/L	5	U	1	U	5	U	1	U	2.6	J	1	U	5	U	1	U	1.1	J	1	U	5	U	1	U	3	J	1	U	5	U	1	U
ZINC	2000	µg/L	10.5	J	57		36.3		27		63.9		72		50		59		7.1		32		30		24		9.9	J	31		21.9		11	
HARDNESS	NA	mg/L	93.7		109		116		91.3		21.2		21.1		18.8		22.2		18.3		18.8		19.5		17.7		16.6		15.9		15.8		14.7	
ORGANIC CARBON, TOT.	NA	mg/L	3		3.2		4.2		3		ND		1	U	1	U	1	U	1.1		1.2		1.1		1.3		ND		1	U	1	U	1.2	
RESIDUE, FILTERABLE (TDS)	NA	mg/L	200		220		180		150		46		97		70		70		37		43		57		43		26		81		48		82	
RESIDUE, NON-FILTERABLE (TSS)	NA	mg/L	19		12		69		19		ND		14		10	U	22		ND		10	U	11		10	U	16		10	U	27		24	
ORGANIC CARBON, DISSOLVED	NA	mg/L	4.2		4.8		4.1		3.7		1.3		1.8		1.9		1.6		1.5		3.3		1.5		1.6		2.8		1	U	1	U	2.5	

Notes:

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Table 3-1
Quarterly Groundwater Results
Zschiegner Refining Company Site
Howell Township, New Jersey

Monitoring Well Location			MW-09S				MW-10S				MW-11S (Duplicate MW-111S)								MW-12S			
Sample Identification			MW-09S-R9	MW-09S-R10	MW-09S-R11	MW-09S-R12	MW-10S-R9	MW-10S-R10	MW-10S-R11	MW-10S-R12	MW-11S-R9	MW-111S-R9	MW-11S-R10	MW-111S-R10	MW-11S-R11	MW-111S-R11	MW-11S-R12	MW-111S-R12	MW-12S-R9	MW-12S-R10	MW-12S-R11	MW-12S-R8
Sample Date			3/20/2012	6/19/2012	9/11/2012	12/24/2012	3/20/2012	6/19/2012	9/10/2012	12/24/2012	3/21/2012	3/21/2012	6/20/2012	6/20/2012	9/10/2012	9/10/2012	12/24/2012	12/24/2012	3/20/2012	6/19/2012	9/10/2012	12/20/2011
Analyzed Compound	Criteria[2]	Unit																				
ALUMINUM	200	µg/L	30.7	**1600**	19.2 J	42	20 U	30 U	14.7 J	38	**637**	**653**	**520**	**610**	**382**	**390**	**560**	**580**	156	120	**246**	150
ANTIMONY	6	µg/L	2 U	1 U	2 U	1 U	2 U	1 U	2 U	1 U	2 U	2 U	1 U	1 U	2 U	2 U	1 U	1 U	2 U	1 U	2 U	1 U
ARSENIC	0.02	µg/L	**0.18**	**1.9**	**0.51 J**	**0.15**	0.1 U	0.1 U	**0.5 J**	0.1 U	0.1 U	0.1 U	**0.13**	**0.13**	**0.47 J**	**0.5 J**	**0.16**	**0.18**	**0.24**	**0.29**	**0.66 J**	**0.31**
BARIUM	6,000	µg/L	125	150	98.2	89	88.6	86	89.1	90	24.2	23.9	25	26	26.7	26.5	22	21	106	62	76	59
BERYLLIUM	1	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.67 J	0.66 J	1 U	1 U	0.8 J	0.77 J	1 U	1 U	1 U	1 U	1 U	1 U
CADMIUM	4	µg/L	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U	0.25 U	1 U	**4.3**	**4.5**	**5**	**5.3**	**4.9**	**4.6**	3.4	3.5	0.1 J	1 U	0.25 U	1 U
CALCIUM	NA	µg/L	11800	9800	8210	8700	7560	7300	7780	8200	14900	14700	13000	13000	12700	12400	12000	13000	12300	6900	9430	7300
CHROMIUM	100	µg/L	1.8 J	33	2.3	6.2	0.7 J	4.1	0.99 J	2 U	**115**	**116**	**150**	**140**	**125**	**122**	**140**	**140**	1.7 J	3	8.4	2.6
COBALT	100	µg/L	0.19 J	1 U	1 U	1 U	0.74 J	1 U	1 U	1 U	1.6	1.6	2	2	1.8	1.7	1.4	1.4	0.17 J	1 U	3	1 U
COPPER	1,300	µg/L	0.59 J	24	5	2.4	1.5 J	7.6	3.3	4.6	213	216	300	290	261	252	240	240	3.7	3.9	16.3	3.1
IRON	300	µg/L	**8610**	**71000**	**5940**	**7700**	**4200**	**4200**	**5100**	**9600**	**423**	**389**	58	76	**621**	**783**	**350**	**440**	**15500**	**7000**	**16800**	**10000**
LEAD	5	µg/L	1 U	**8.8**	0.83 J	1 U	1 U	1 U	1.8	1	1.8	1.5	1.7	1.6	2.8	3.1	1.2	1 U	2.7	1.4	2.7	2.9
MAGNESIUM	NA	µg/L	3480	2900	2400	2400	2200	2100	2170	2300	2960	2940	2500	2500	2440	2350	2400	2400	3590	1700	2400	1800
MANGANESE	50	µg/L	**227**	**110**	**72.7**	**110**	**79.9**	50	**51.3**	**64**	**53.7**	**53.8**	**52**	**54**	**62.1**	**61.2**	**63**	**66**	**141**	**57**	**101**	**71**
MOLYBDENUM	40	µg/L		3.8		1 U		1 U		1 U			1 U	1 U			1 U	1 U		1 U		1 U
NICKEL	100	µg/L	1.8	21	1.8	1	1.1	3.1	0.88 J	1 U	**347**	**350**	**380**	**370**	**272**	**267**	**220**	**220**	1.2	1.5	16	1.3
POTASSIUM	NA	µg/L	2830	2800	2920	2700	2530	2600	3130	2800	4230	4140	3300	3400	4480	4370	4100	4200	3330	2100	2660	2300
SELENIUM	40	µg/L	5 U	1 U	5 U	1 U	5 U	1 U	5 U	1 U	0.73 J	0.71 J	1.1	1.1	5 U	5 U	1.1	1.3	5 U	1 U	5 U	1 U
SILVER	40	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SODIUM	50000	µg/L	9570	10000	7580	8500	8280	8900	7410	9600	33700	33900	38000	38000	27700	27700	31000	32000	21000	7900	9620	8200
THALLIUM	0.5	µg/L	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U	0.24 U	0.24 U	0.5 U	0.5 U	0.24 U	0.24 U	0.5 U	0.5 U	0.24 U	0.5 U	0.24 U	0.5 U
VANADIUM	60	µg/L	1.1 J	4.3	5 U	1 U	2.4 J	1 U	5 U	1 U	5 U	5 U	1 U	1 U	5 U	5 U	1 U	1 U	2 J	1 U	4.1 J	1 U
ZINC	2000	µg/L	3.5 R	46	31.2	18	6.4 J	23	22 J	31	274	274	320	310	309	305	220	230	6.2 J	11	58.3	7.9
HARDNESS	NA	mg/L	43.8	36.1	30.4	31.6	27.9	26.7	28.4	30.2	49.4	48.8	42.3	42.7	41.8	40.6	40.9	42.3	45.5	24.2	33.4	25.7
ORGANIC CARBON, TOT.	NA	mg/L	2.2	4.2	1.4	2	1.1	1 U	1 U	2	2.3	2.3	1.7	1.6	1.9	1.9	2.9	2.9	1.2	1.1	1.9	1.2
RESIDUE, FILTERABLE (TDS)	NA	mg/L	63	120	65	73	52	51	92	110	160	140	230	210	190	180	140	170	78	91	81	67
RESIDUE, NON-FILTERABLE (TSS)	NA	mg/L	11	230	20	32	ND	10 U	10	25	ND	ND	10 U	10 U	10 U	10 U	10 U	10 U	18	16	140	40
ORGANIC CARBON, DISSOLVED	NA	mg/L	2.4	2	1	1.6	4.8	1.4	1.6	1.8	2.3	2.4	2.2	1.8	1.9	2	3	3	1.5	1.5	3.4	1.6

Notes:

1. Values detected in exceedence of screening criteria are highlighted and bolded; rejected values are highlighted in red.
2. Criteria for Chromium and Nickel are remediation goals set forth in the ROD (EPA, 2004). All other criteria based on New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C).

Acronyms:

bgs - below ground surface
J - estimate result value
K - estimate result, biased high
mg/L - milligram per Liter
NA - not applicable
ND - not detected
R - rejected result
U - non-detect
µg/L - microgram per Liter
TDS - Total Dissolved Solids
TSS - Total Suspended Solids
TOT - total

Table 3-2
Groundwater Field Parameters
Rounds 5 through 8 Groundwater Sampling
Zschiegner Refining Company Superfund Site
Howell Township, New Jersey

Monitoring Well Location	Sample Identification	Sampling Date	Final Depth to Water (ft. TIC)	Flow Rate (mL/min)	Total Volume Purged (Liters)	pH	Specific Conductivity (mS/cm[c])	Turbidity (NTUs)	DO (mg/L)	ORP (mV)	Temperature (^{o}C)
MW-01D[1]	MW-01D-R9	3/21/2012	0.00	250	21.5	5.57	0.137	32.90	0.2	66.6	12.95
	MW-01D-R10	6/18/2012	0.00	250	11.5	5.62	0.130	30.80	0.22	61.8	17.04
	MW-01D-R11	9/10/2012	0.65	600	42.0	5.71	0.120	33.2	0.05	89.3	14.67
	MW-01D-R12	12/27/2012	0.00	300	1.0	5.84	0.143	18.90	0.23	32.3	12.51
MW-01S	MW-01S-R9	3/21/2012	4.91	250	61.0	5.46	0.072	48.20	0.28	113.8	12.93
	MW-01S-R10	6/18/2012	4.90	250	21.0	5.23	0.065	41.40	0.67	208.4	16.52
	MW-01S-R11	9/10/2012	4.00	250	8.75	4.94	0.063	91.0	1.89	181.4	20.65
	MW-01S-R12	12/27/2012	4.74	200	6.0	4.7	0.062	59.50	0.45	242.3	12.57
MW-02RS	MW-02RS-R9	3/20/2012	6.19	250	18.0	8.05	0.481	17.60	0.04	-164.6	17.88
	MW-02RS-R10	6/19/2012	5.92	250	9.0	8.15	0.406	11.70	0.04	-162.6	20.73
	MW-02RS-R11	9/11/2012	5.57	150	18.0	9.75	0.385	9.51	4.72	-152.8	22.67
	MW-02RS-R12	12/26/2012	5.66	200	6.0	8.25	0.579	17.60	0.16	-130.1	11.86
MW-03RD	MW-03RD-R9	3/19/2012	5.04	250	31.5	5.76	0.080	6.11	0.23	-65.6	14.01
	MW-03RD-R10	6/20/2012	5.57	250	12.0	5.72	0.080	13.90	0.18	57.8	17.75
	MW-03RD-R11	9/11/2012	5.76	250	21.5	4.65	0.077	22.6	0.38	546.1	16.23
	MW-03RD-R12	12/26/2012	5.13	200	3.0	5.79	0.082	5.12	0.30	-1.7	12.03
MW-03RS	MW-03RS-R9	3/19/2012	5.77	250	13.5	4.33	0.306	3.22	3.11	358.5	13.84
	MW-03RS-R10	6/20/2012	6.27	250	11.5	3.89	0.324	4.02	2.96	355.8	19.11
	MW-03RS-R11	9/11/2012	5.99	200	4.73	4.80	0.334	4.75	1.99	301.3	19.19
	MW-03RS-R12	12/26/2012	5.80	250	1.5	5.35	0.372	8.50	2.81	194.3	13.13
MW-04RS	MW-04RS-R9	3/20/2012	8.41	250	11.8	4.78	0.307	12.20	5.97	347.9	12.36
	MW-04RS-R10	6/19/2012	8.79	250	12.0	4.48	0.278	6.68	5.24	365.7	12.36
	MW-04RS-R11	9/11/2012	9.39	250	21.0	4.64	0.255	4.80	0.08	244.4	20.6
	MW-04RS-R12	12/26/2012	8.05	200	2.0	4.69	0.278	11.00	5.77	287.3	11.08
MW-05D	MW-05D-R9	3/19/2012	7.93	250	14.5	5.50	0.080	4.08	2.97	108.3	16.00
	MW-05D-R10	6/18/2012	8.41	250	19.0	5.30	0.077	27.80	0.28	135.6	14.91
	MW-05D-R11	9/10/2012	8.51	200	13.25	4.88	0.086	27.0	1.02	254	17.84
	MW-05D-R12	12/26/2012	8.06	300	4.0	5.40	0.086	11.50	0.35	85.7	12.12
MW-05S	MW-05S-R9	3/19/2012	8.18	250	21.0	5.23	0.315	3.48	4.08	270.5	13.45
	MW-05S-R10	6/19/2012	8.71	250	12.5	5.40	0.323	1.20	3.69	249	17.28
	MW-05S-R11	9/10/2012	10.70	200	15.14	5.27	0.265	2.5	0.83	413.7	21.98
	MW-05S-R12	12/26/2012	8.28	300	4.0	5.41	0.240	5.10	1.91	104.2	13.53
MW-06RS	MW-06RS-R9	3/20/2012	13.50	250	27.3	5.86	0.388	4.11	5.84	204.2	15.02
	MW-06RS-R10	6/19/2012	13.71	250	13.0	5.87	0.375	9.88	5.08	163.1	17.2
	MW-06RS-R11	9/11/2012	14.14	250	13.5	5.70	0.367	35.6	11.9	188.8	18.98
	MW-06RS-R12	12/26/2012	13.50	250	4.5	5.83	0.320	10.96	4.92	138.9	14.22
MW-07D	MW-07D-R9	3/21/2012	11.78	250	13.5	6.21	0.112	2.63	1.94	116.2	14.79
	MW-07D-R10	6/18/2012	12.36	250	12.0	6.04	0.101	7.04	1.69	39.3	16.03
	MW-07D-R11	9/10/2012	12.71	200	8.52	5.88	0.088	2.25	0.01	175.5	16.28
	MW-07D-R12	12/27/2012	11.90	300	3.0	6.22	0.118	8.80	0.31	16.8	13.58
MW-07S	MW-07S-R9	3/21/2012	11.70	250	14.5	5.02	0.105	2.17	7.98	270.2	15.91
	MW-07S-R10	6/18/2012	12.51	250	10.0	4.91	0.110	11.90	7.36	240.9	16.86
	MW-07S-R11	9/10/2012	12.62	200	15.14	5.08	0.103	16.5	0.40	360	20.43
	MW-07S-R12	12/27/2012	11.90	250	1.5	5.19	0.093	8.10	8.56	237.0	14.97
MW-08S	MW-08S-R9	3/20/2012	2.71	200	13.0	5.41	0.078	15.23	0.65	29.2	12.83
	MW-08S-R10	6/19/2012	3.22	250	8.0	5.65	0.084	5.48	0.15	22.3	18.30
	MW-08S-R11	9/11/2012	2.65	150	7.5	5.85	0.093	18.1	3.66	47.9	22.33
	MW-08S-R12	12/24/2012	2.84	300	2.0	5.46	0.074	14.50	3.64	116.9	9.23
MW-09S	MW-09S-R9	3/20/2012	3.40	250	31.5	5.84	0.188	21.80	0.25	-76.7	12.09
	MW-09S-R10	6/19/2012	3.66	250	20.0	5.53	0.185	37.80	0.25	35.7	17.03
	MW-09S-R11	9/11/2012	3.59	200	7.57	5.54	0.160	31.1	0.00	59.5	20.13
	MW-09S-R12	12/24/2012	3.46	200	5.0	5.46	0.143	49.90	0.24	-66.2	10.23
MW-10S	MW-10S-R9	3/20/2012	4.30	250	15.0	5.22	0.136	5.96	0.51	77.0	13.94
	MW-10S-R10	6/19/2012	4.48	250	12.0	5.37	0.139	3.85	1.03	91.7	19.45
	MW-10S-R11	9/10/2012	3.60	150	3.75	5.62	0.153	17.5	1.44	61.4	21.45
	MW-10S-R12	12/24/2012	3.68	250	3.0	5.35	0.490	45.50	4.70	105.4	8.78
MW-11S	MW-11S-R9	3/21/2012	3.80	250	22.0	4.96	0.355	1.00	10.37	257.3	11.26
	MW-11S-R10	6/20/2012	4.27	250	12.0	4.60	0.334	1.04	11.88	376.8	18.29
	MW-11S-R11	9/10/2012	4.68	150	3.0	4.71	0.314	8.2	3.06	291.3	21.5
	MW-11S-R12	12/24/2012	3.72	250	2.0	4.86	0.298	2.29	4.15	310.3	9.48
MW-12S	MW-12S-R9	3/20/2012	4.50	250	38.0	5.75	0.170	40.00	0.19	-38.1	13.36
	MW-12S-R10	6/19/2012	4.78	250	20.0	5.63	0.113	18.90	0.6	71.6	17.39
	MW-12S-R11	9/10/2012	4.29	250	18.5	5.63	0.097	44.4	0.00	72.5	21.13
	MW-12S-R12	12/24/2012	4.27	200	4.0	5.33	0.115	42.00	2.69	166.3	12.42

Notes:

[1] This is a flowing artesian well - flow can not be controlled

ft - feet
TIC - Top of Inner Casing
mL/min - milliliter per minute
mS/cm[c] - milliSiemen per centimeter
NTU - Nephelometric Turbidity Units
mg/L - milligram per Liter
mV - milliVolt
^{o}C - degree Celcius
DO - Dissolved Oxygen
ORP - Oxidation Reduction Potential